1983 ANNUAL REPORT SUMMARY

Salmonid Enhancement Program

Canada

Province of British Columbia

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Fisheries and Oceans / Pêches et Océans

Province of British Columbia / Ministry of Environment

Salmonid Enhancement Program
Department of Fisheries and Oceans
1090 West Pender Street
Vancouver, B.C.
V6E 2P1

Director's report

The future of SEP was the major area of interest and concern in 1983, the final year of Phase I. The most significant event of the year was government approval of the Transition Phase to run through to March 31, 1986, and the commitment to funding a continuation of the work that was established in Phase I.

There were also major achievements in the area of integration with the Pacific Region of DFO.

The appointment of SEP's director as associate director-general for the Pacific Region, the inclusion of SEP in the development of new management strategies for Pacific fisheries, the integration of finance and planning functions and closer cooperation in the communication and information area gave visible evidence of the commitment to greater integration.

The year also brought problems and challenges. The impact of reductions in funding and in person-year allotments during the last year of Phase I had to be overcome. The approval of the Transition Phase was welcome confirmation of the government's faith in, and commitment to, the enhancement program.

As expected during the final year of Phase I, a great deal of time was spent planning for the future. These planning activities were carried out with the support and involvement of the Salmonid Enhancement Board, the Salmonid Enhancement Task Group and the Regional Planning Branch. The open information policy of SEP, and its ability to gain access to public and user group concerns were a very valuable part of this process.

The decision to proceed with a Transition Phase made it necessary to adjust plans to incorporate the basic elements of the Transition Phase:

- the continuation of all existing SEP operations: major facilities, lake enrichment, community economic development, public involvement, information and education programs
- evaluation of Phase I and how it has met its objectives
- closer integration with the Pacific Region of DFO
- the provision of additional funds to work with threatened chinook stocks, particularly in the upper Fraser River
- planning for a smooth continuation of SEP in future years.

New projects which would require significant ongoing costs of operations beyond 1986 will be postponed until conclusion of the Transition Phase and the completion of Phase I evaluations.

Major emphasis will be placed on evaluating both the accomplishments and methods of SEP over the past seven years. This evaluation procedure is intended to assure the effectiveness of all future plans and activities.

Fish production, socioeconomic benefits and operating methods such as contracting-out will be closely examined during the next two years. Biologists point to the difficulty of making a firm assessment of contributions to fish production after so little time, but the early returns to the SEP facilities are encouraging. Similarly, the results from lake enrichment are viewed as successful, although it will take further time and study to assess the degree of that success.

The assessment program will also examine the nature of the interaction between hatchery and wild stocks. This issue is both complex and of significance to the future direction of the enhancement program.

The policy of contracting-out will be examined in some depth during the Transition Phase, and policies regarding the nature and extent of this method of operation will be developed.

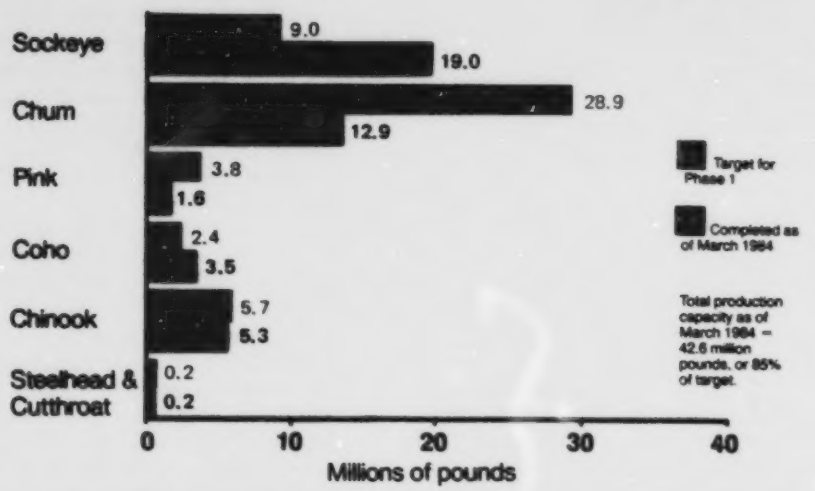
In summary, the Transition Phase is designed to ensure that future enhancement is compatible with fishery management plans. In this regard, it is encouraging to note the strengthened involvement of SEP in fisheries management policy decisions.

As the first phase of SEP concludes, there have been strong indications of success. The contribution to the sport, commercial and native fisheries appears to be substantial. There has clearly been a positive impact on many communities through CEDP and job creation programs, an impact on both employment levels and available expertise. As well, there have been very substantial benefits in the area of improved understanding between SEP, DFO and the public. Public and user groups will play an important role in the future of both SEP and the Department; the groundwork has been laid that will make that role a positive one. Over the long term, this may prove to be one of the greatest achievements of SEP, Phase I.

N.W. Falkner, Ph.D.
Director, SEP

Matching performance with goals

Figure 1: SEP Production Capacity by Species: Phase 1 Targets and Performance to Date*



*Production capacity measures the capacity of facilities which have been constructed since 1977 (SEP facilities only) and are now operational. The capacity is stated in terms of expected future adult catches, using current facility capacities, current expected egg to adult survival rates of enhancement techniques, and projected future Canadian catch rates.

SEP contributes to the economic and social well-being of society through its expenditures on construction and operation of enhancement facilities and by increasing the catch of salmonids.

The economic viability of SEP is directly related to its performance in terms of fish production.

Current production capacity estimates indicate SEP has achieved approximately 85 percent of its original target, despite the substantial decline in the real value of the funds approved for Phase I, so significant economic benefits can be expected from SEP.

The program will also realize many of its social objectives, since they are related to fish production. For instance, short-term employment has been generated from the construction and operation of enhancement facilities, while more significant long-term employment will be realized in the harvesting and processing sectors as a result of increased catches.

Employment opportunities

Native people have been involved in the planning and execution of projects in their home communities and will also benefit from SEP production.

The Community Economic Development Program (CEDP) is designed to provide special employment opportunities for residents of remote communities, many of which are native communities. Incorporating institutional and on-the-job training, this component also imparts technical and managerial skills to native people. This stimulates their participation in managing and conserving the resource.

Twenty-six CEDP projects were undertaken in Phase I. Approximately 430 person-years of employment for native people were created in the twenty-six communities through CEDP in Phase I. The vast majority of the people employed on these projects had been unemployed. A review of this program by a consultant concluded that the training component was highly successful.

Fisheries based upon enhanced salmon are the major source of earnings and a prime catalyst of economic activity for many smaller coastal communities. SEP's contribution to regional development can be considered significant in light of the production capacity attained. As well, approximately 75 percent of labor employed on SEP major capital projects was from rural areas. This is a considerably higher proportion than is found in many capital works projects specifically designed for local employment.

This year was also marked by the development of new and more accurate methodologies for economic evaluation of SEP's five accounts system. This new system will be in full operation in 1984 and will be used for all future economic evaluations.

SEP facilities: major contributors

Phase I of SEP came to an end with 1983 and, appropriately, the year was marked by the opening of two new facilities, Kitimat and Eagle River hatcheries.

The $9.6 million Kitimat facility is one of the largest and most complex of the SEP installations and is expected to be a major contributor to chum, coho and chinook stocks. It draws upon the nearby Eurocan pulp mill for heated water to aid in rearing salmonids under optimal conditions. The hatchery will also enhance pink salmon and steelhead trout. A total of 22 stocks in the area will benefit from the work of this facility, which will contribute almost 300,000 adult fish to the region when operating at capacity.

The Eagle River hatchery, a $500,000 pilot project, is located some 70 km east of Salmon Arm. It will enhance chinook and coho stocks in that area, and it can be expanded to work with other stocks as well. The facility's most unique aspects are its location far up the Fraser/Thompson River systems and its provision for early expansion into a full-scale facility to meet enhancement objectives in the area. It is expected to provide valuable information on enhancement techniques and opportunities for the Fraser and its tributaries.

As the construction activities of Phase I concluded, the emphasis on assessing and evaluating the program's results to date increased. Since fish enhancement is, by definition, a process of working with nature, it is not surprising that the results over the years should be varied. In general, the production of juveniles from SEP facilities in 1983 was up over 1982, and in many cases there were record releases.

1983 releases

The 1983 figures show a small increase in the production of coho, and increases of over 30 percent in the releases of chinook, chum, steelhead and cutthroat.

There were some disease problems in 1983 as well; proliferative kidney disease (PKD) was detected in steelhead at Puntledge River hatchery. This disease had been unknown in Canada and is extremely rare in the United States. By the time the fish were ready for release, the disease was nondetectable. Since PKD is very difficult to diagnose, it is possible that there have been previous outbreaks in Canada which have not been recognized. The research programs which form part of SEP's activities may provide the answer to this and many other such questions over the next several years.

In total, SEP facilities released over 392 million fish in 1983, and these are expected to produce adult returns of over 5 million pieces. Only pink salmon are expected to produce lower returns because of reduced releases in 1982.

Pink fry production was down by about 66 percent because of the lack of returning adult spawners. Pink runs are being intercepted in the Johnstone Strait sockeye fishery, and the impact upon numbers of returning adults has been very severe in recent years. Enhancement efforts, which have been mostly experimental, will have to be increased if this problem is to be overcome. Sockeye fry production was also somewhat reduced in 1983. Difficulties with algae growing in the Fulton spawning channels at Babine was a contributing factor.

Adult returns

Reductions in juvenile production figures usually reflect previous drops in the number of adults returning to spawn. This was true in 1983. Many of the Georgia Strait chinook runs have

been declining for several years. The reasons remain a mystery; it may be a change in the ocean environment, overfishing of these stocks, or a combination of both. This decline continued in 1983.

There were, however, some bright spots for chinook enhancement, notably at the Robertson Creek facility which has been very successful. Chinook returns to the hatchery there, in spite of considerable fishing pressure, are substantial.

Chinook from Robertson Creek are now forming the foundation for a very popular sport fishery in Alberni Inlet and Barkley Sound. A significant number of chinook weighing over 23 kg (50 lbs) have been caught there over the past several seasons. Starting in 1983, chinook from Robertson Creek are being raised for release at the Thornton Creek hatchery to establish a sport fishery in the Ucluelet area.

Good returns of three-year-olds are an early indication that the chinook facilities on the Fraser River will be also very successful.

Returns of pinks in 1983 were disappointing, particularly at Jones Creek spawning channel on the lower Fraser. This facility has a capacity of about 2,500 spawners. Jones Creek has an odd-year run of pinks, but in 1983, only 973 fish returned, a drop of 62 percent. While low water levels in the creek in 1983 may have contributed to the reduced return, the main reason would seem to be very heavy fishing of the stock.

Results from the Japanese-style chum hatcheries were disappointing when surveyed in 1981; 1983 results, however, were more encouraging. While ocean conditions here and the nature of our stocks are somewhat different from those in Japan, the current findings do point to a successful program being established at our new facilities.

Experience gained during Phase I is also paying off in the development of more effective techniques for fish culture, such as better understanding of the nature of aquifers as water sources, greater awareness of habitat enrichment possibilities, better understanding of biological processes, increased knowledge of imprinting and many other elements that will make future enhancement efforts more effective.

Table 1: Distribution of Adult Production* from SEP Major Federal Facilities

Species	North	South	Fraser	Total
Coho	11,100	620,500	80,100	711,700
Chinook	17,900	843,200	95,000	956,100
Chum	158,500	958,500	354,200	1,471,200
Pink	—	100,000	—	100,000
Sockeye	2,000,000	—	—	2,000,000
Steelhead	1,200	18,500	9,700	29,400
Cutthroat	—	500	2,100	2,600
TOTAL	2,188,700	2,541,200	541,100	5,271,000

*Total adult production, in pieces, from 1983 juvenile releases. This production will be in the fisheries and returning to spawn in the years 1984 to 1987, depending on the species and age of the fish.

Provincial perspective

Provincial involvement in SEP focuses on the production and management of steelhead and cutthroat trout stocks. Hopes that the proper combination of enhancement and management techniques can benefit these stocks were encouraged in 1983 with some of the best returns in many years.

Continued federal-provincial cooperation was a positive aspect of 1983. The Skeena River fishery, which harvests an enhanced sockeye population and catches steelhead incidentally, provides a good example. There was a need to find ways to protect the area's reduced steelhead population from being caught incidentally in the sockeye harvest. The Skeena Management Committee, which is made up of representation from both levels of government and from the user groups, has been developing the area's fishing plan for a number of years. Better knowledge of the timing of various runs has allowed this group to manage the sockeye harvest so as to leave "windows" for steelhead escapement while retaining acceptably high sockeye catches.

Steelhead populations around the province have increased due to restrictive management practices, enhancement efforts, and the continued cooperation of anglers. Anglers are enjoying much improved fishing on a number of systems including the Vedder and several Vancouver Island rivers.

Cutthroat trout continue to present management problems. They remain low in numbers and are easily caught. More work is being done on cutthroat biology and enhancement, although not on the scale of the steelhead program.

Stream enrichment, analogous to lake enrichment, has been tested on the Keogh River. Numbers of insects and amounts of algae increased as a result, and this should lead, in turn, to increased fish production.

Habitat projects are an ongoing part of "natural" enhancement. The Province has been particularly involved in projects on the Thompson-Nicola portion of the Fraser system. Streams there offer great potential as nursery areas if cooperative arrangements can be made with ranchers and other users of the scarce water resource. Proper habitat management remains one of the easiest and cheapest ways to produce fish.

Another technique which shows promise is outplanting fry to underutilized habitat. This can yield increased returns in areas such as the Skeena where rearing steelhead to smolt stage is not planned.

These techniques and growing cooperation among the provincial and federal governments and the public give hope that the objective of developing a balanced management plan where most of the river systems will meet their natural capabilities can be achieved.

Engineering

For engineering, the final year of SEP Phase I saw the last of the major projects reaching completion, and it was time to follow up on a myriad of details required to make these projects fully effective. A great deal of effort was expended in reconnaissance and feasibility studies for new projects.

Changes occurred in administrative areas and in the activities that were carried out during the year. Early in 1983, cuts in person-years made it necessary to lay off some personnel. This shifted a greater burden on to remaining staff.

Much of the activity undertaken during 1983 reflected what the future will hold, at least for the next two years. The types of projects to be undertaken will be different; the emphasis will shift from construction of new pilot projects and major facilities to upgrading of existing facilities and to habitat improvement efforts, both of which can produce additional fish without significantly increasing operating costs.

The only new facilities built during 1983 were at Spius Creek, Clearwater River, Stuart River and Shuswap Falls. Funding from a Government of Canada Special Employment Initiative for the interior of the province allowed these projects to proceed at a pilot scale, although lack of funds in Phase I of SEP had previously indicated that they would have to be postponed.

Other engineering activity was focused on upgrading and enlarging existing facilities. In some cases, these improvements were required to overcome groundwater supply problems. Difficulties in locating reliable groundwater sources have been common to hatcheries, but with increased experience it is becoming easier to find solutions.

In other cases, once operations have commenced, some facilities have seen the potential for increased production, or for opportunities to work with another species. Such opportunities may require either alteration or expansions of the facility. One of the goals for the next few years will be to see that each facility reaches its optimum production level. In many cases, doing so may demand major expansions or improvements.

New directions

Another growing focus is the creation of projects which increase production while requiring less human intervention. Unattended habitat improvement projects are particularly useful for streams and rivers in the more remote areas of the province.

There are two significant advantages to projects of this type. One is the major saving in long-term cost, since staffing and supplying permanent facilities in such areas would be expensive. The second is that such projects can greatly stabilize production. Many of the coastal streams in B.C., such as the Kakweiken River, are subject to sudden floods caused by heavy fall and winter rains. These floods can easily wipe out in a few hours all the production gained by getting more fish to spawning grounds.

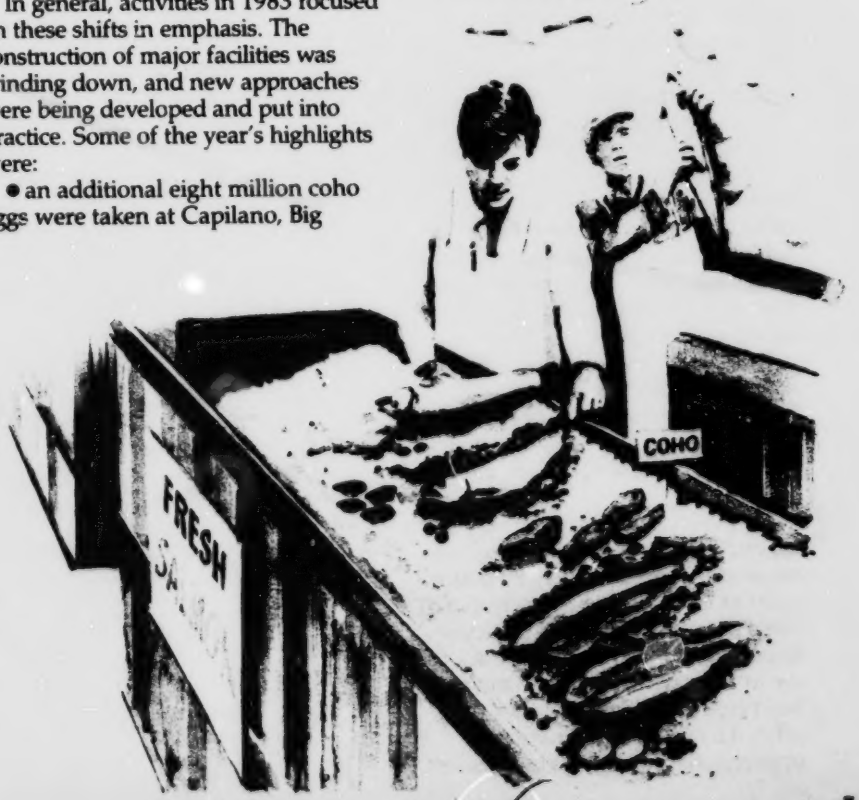
Another effort at habitat improvement and restoration concentrates on estuaries. Due to the very complex interactions that occur in estuaries, these efforts often need long development times. SEP is cooperating with habitat biologists in developing estuary enhancement plans and techniques.

In general, activities in 1983 focused on these shifts in emphasis. The construction of major facilities was winding down, and new approaches were being developed and put into practice. Some of the year's highlights were:

- an additional eight million coho eggs were taken at Capilano, Big Qualicum, Quinsam and Chilliwack to double the hatchery coho catch in Georgia Strait in 1986 for Expo
- several of the major facilities were involved in time and size at release, diet, imprinting, heritability of adult traits (run timing, flesh color), and sex control studies
- Kitimat hatchery started operations
- Eagle River pilot hatchery started operations
- Kitsumkalum and Penny pilot operations were closed; their objectives were achieved and evaluation will occur when fish return through 1987
- The computer programs known as the Fish Culture Information System for Hatcheries (FISH) were completed.

Looking ahead

In general, 1983 was a year of finishing what was started, improving what already existed, and planning for the future. The lessons of Phase I were reviewed during 1983 and this process will continue in the following year as SEP charts enhancement operations for 1986 and beyond.



Community development

The number of projects operating under the Community Economic Development Program (CEDP) increased dramatically in 1983, from 14 to 26. Of these, seven were jointly-funded with the Local Employment Assistance Program (LEAP).

CEDP contracts with local groups for enhancement projects. These contracts usually involve the operation of small hatcheries at various locations in B.C. The program has been a vehicle for native and community involvement with SEP production activities. Of the 26 contracts in place in 1983, 19 are with native bands or tribal councils.

There are two objectives for CEDP projects: to train people in enhancement techniques to increase fish production and second, to provide local employment. For the most part, both of these objectives were met successfully in 1983.

Releases of juveniles from all operating projects totalled over 12 million fry and smolts. These releases are expected to add 365,000 pieces to the various fisheries between 1985 and 1987.

On the local employment side of the ledger, CEDP projects have also been successful. Approximately 90 person-years of employment were created by these projects in 1983. Of particular importance is the fact that these jobs are in areas where unemployment has been especially high, and they have offered a considerable number of opportunities for native employment.

New projects

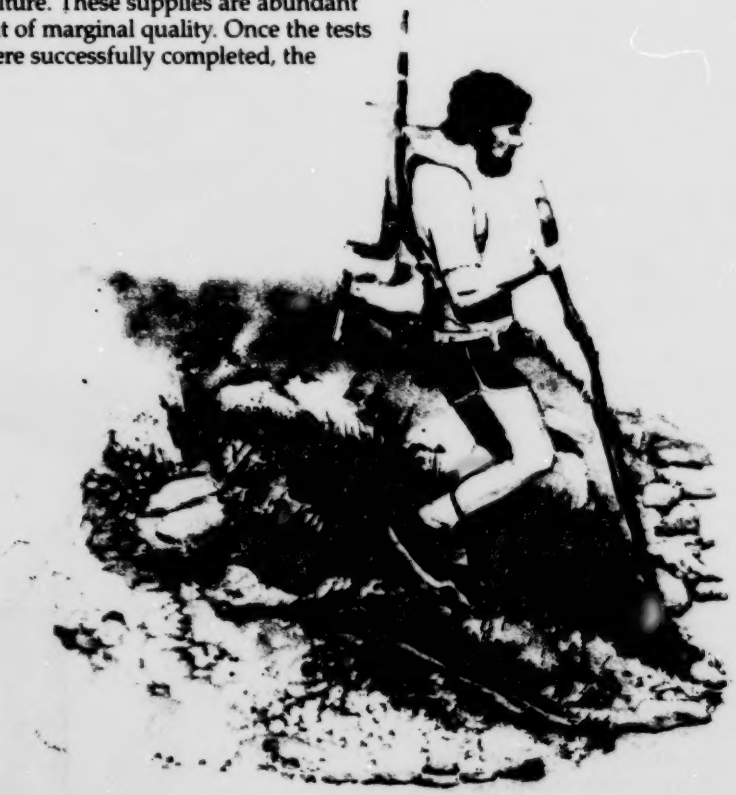
New projects were a major focus for CEDP in 1983, as the Employment Related Initiatives funding provided for considerable expansion of the program:

- at Port Hardy, two hatcheries were built and began operation under a contract with the Northern Vancouver Island Salmonid Enhancement Association. The two facilities, Quatse, located just off Coal Harbour Road, and Stephens Creek, on the outskirts of Coal Harbour, on the west coast of Vancouver Island, have the combined capacity to rear 6 million fry annually. Both will operate as satellite facilities, releasing chum, pink and coho fry back to their creeks of origin
- a small hatchery was constructed on Lang Creek south of Powell River to enhance local coho stocks
- at Terrace, where excellent groundwater sources were found, a hatchery has been built which can rear up to 500,000 chinook, coho and steelhead
- the Fort St. James project began as a pilot facility to test the suitability of local groundwater supplies for fish culture. These supplies are abundant but of marginal quality. Once the tests were successfully completed, the facility itself became available. A contract was drawn with the Necoslie Band to continue operations, and production began with the taking of 45,000 Stuart River chinook eggs in the fall of 1983. When operating at current capacity, this facility will be capable of releasing 120,000 chinook smolts annually.

Project highlights

Significant work continued at the existing CEDP projects as well:

- the small hatchery at Chehalis, operated by the Band as a training facility, was shut down due to the completion of the Chehalis River major facility. The contract for 1983 redirected the Band's efforts to stocking incubation pits and groundwater-fed side channels and monitoring their function
- the water supply problems which have plagued the Kincolith project were finally solved in 1983, and the facility released 118,000 coho fry into



the upper reaches of the Kincolith River. This represented a survival rate of 91 percent

- a new longhouse-style hatchery building was put up by the Masset CEDP on Graham Island. Incubation there has been shifted from a very large upwelling incubator to Heath trays to overcome siltation problems
- the Nimpkish project solved problems of too-small and too-late chum fry due to cold water temperatures at the Willow Creek hatchery by starting a pilot at Cheslakees (near the mouth of the Nimpkish River) to make use of a warmer water supply available there. The project also reared its first small batch of chinook successfully at Willow Creek
- a new hatchery building was built for the Sechelt project to accommodate the adult chinook and coho which returned to the net-pen site where they had been reared and released
- in the Lower Mainland, the long-standing project with the B.C. Institute of Technology continued its successful enhancement of steelhead and coho on the Seymour River. The children's fishery at False Creek, a popular annual event which uses chinook reared at the BCIT project, was not held in 1983. It was felt that it would be inappropriate to proceed with this fishery while chinook stocks were in jeopardy. Instead, those fish were released as production fish. The children's fishery will be reinstated later using coho stocks.

Overall, the CEDP projects were maturing during the final year of Phase I. Growth in knowledge and experience has resulted in increased production at most facilities. Problems of developing and maintaining adequate water supplies at some early projects, once a major impediment, have now been resolved by the cooperative efforts of the contractors, CEDP staff and Small Projects Unit support staff. As Phase I comes to a conclusion, releases from the early years at many of these facilities are producing results; adult fish are returning in increasing numbers. The returns should grow with the passing years as the increased production success is reflected in significant contributions to the sport, commercial and native fisheries.

Job creation

Combined funding from Department of Fisheries and Oceans and the Canada Employment and Immigration Commission for job creation totalled $4.3 million. These funds created over 13,400 person-weeks of employment on SEP projects. SEP employment objectives were further served by the fact that 29 percent of these person-weeks were in jobs held by native workers.

The activities funded through job creation included fish production, information gathering, habitat improvement and facility expansion.

Projects ranged in size from some quite large activities undertaken with various municipalities and involving more than 50 individuals, down to very small projects involving only two or three.

A wide variety of groups participated in these activities; local salmonid enhancement societies, fish and game clubs, commercial fishermen's organizations and a number of native bands and tribal councils.

The program was administered by a special Job Creation Unit within SEP. Its staff provided both administrative and technical support.

The prime benefit of this program was, of course, employment, particularly in those areas of the province which have suffered most acutely from the recession. There was, however, a very real benefit to DFO as well. These were not "make-work" job creation projects. The activities which were funded were all of real and direct value. Many enhancement efforts were either undertaken, or expanded, solely because this funding source was available.

Work done

Projects were located all across B.C. and focused upon different types of activities as local needs dictated. Some examples are:

- information gathering: spawner enumerations were conducted throughout the Fraser Valley and in the Squamish-Pemberton area; stream obstructions were assessed near Campbell River; a stream and estuary assessment was carried out in Clayoquot Sound. Tagging activities were also undertaken in several areas
- habitat improvement: Owikeno Lake and Kootowis and Staghorn Creeks were cleared and a flow control project was carried out at Bella Bella
- facility expansion: a number of hatcheries which had been awaiting funding for expansions and modernization work were beneficiaries of the program. The scope and efficiency of their operations were increased considerably because of the work done
- fish production: this was also increased as several new projects were brought into being, wholly or partially, as a result of the job creation program in 1983.

As well, educational and informational materials were provided or improved as part of the job creation efforts.

The benefits of the job creation program have been felt at locations throughout the province as jobs have been created for individuals in various fish enhancement and fish culture areas. As well as immediate employment, these people have gained job experience and new skills. These benefits, like those from increased fish production, will continue to pay dividends to the province for years to come.

Education, advice, participation

The public involvement portion of SEP, once considered almost revolutionary, has become one of the most successful and highly-valued components of the program.

In 1983, close to 7,000 volunteers bestowed their labor, and their love, upon the resource. Fish in more than 150 streams in the province were the beneficiaries.

Making it work

The efforts and enthusiasm of SEP volunteers is coordinated by nine community advisors (CAs). These individuals occupy a role still unique in government; they are the channels through which citizens can direct their participation as partners in a government department's activities. The experiment has worked, and it has worked very well. Streams throughout B.C. have been rehabilitated, monitored and stocked with fish because of this program. Enthusiasm remains high among both the volunteers and the CAs. There has been a significant gain, not only in fish production and environmental quality, but also in cooperation and understanding. This understanding is found in groups ranging from elementary schoolchildren to pensioners. It encompasses both the sport and the commercial fisheries. The growing conviction that caring for the resource is everyone's responsibility has been a significant long-term gain for the resource. In addition, streams have been improved and the releases of fry and smolts are expected to add 117,863 pieces to the various fisheries between 1985 and 1987.

Just as the public involvement projects provide a way for citizens to become involved in the production activities of SEP, so the Salmonid Enhancement Task Group provides an opportunity for the public to become involved in its planning activities. This 19-member group serves as a channel from the general public, and the resource users, to SEP management. The members represent diverse interests and opinions. They have, however, shown cohesiveness on one subject; they all believe in the betterment of the salmonid resource.

With the establishment of the Transition Phase, SEP entered into a period of planning and decision-making. This has already begun to have an impact upon the role of the Task Group. Its members have been called upon to become involved in considering the various options and in planning how to get maximum effect from the Transition Phase while avoiding projects which would create ongoing operational costs. The perspectives they can provide as public representatives considering these requirements are of particularly high value.

Public information

One of SEP's goals from the beginning was to provide information about the resource to the public, the schools, and the user groups. This function was served in 1983 through the creation of informational displays at three hatcheries, the release of a slide-tape presentation about public involvement, the development of a primary level educator's package and the continued publication of SEP's newsletter, *Salmonid*.

As well, the SEP display was seen at six locations around the province, and smaller displays were used by community advisors at public meetings and school visits in their regions.

SEP maintains a liaison with the school system through the program's educational coordinator whose major responsibilities are:

- writing and editing material for the curriculum package *Salmonids in the Classroom*
- conducting in-service sessions for users of the package
- providing input to the development of SEP information materials
- maintaining liaison between DFO staff and the educational community.

In 1983, the coordinator's efforts were concentrated primarily on development of an education package for classroom use by DFO staff members.

As well, workshops were held to introduce the new two-volume version of the educator's package. One volume is for elementary level and one for secondary schools. Work also proceeded on development and testing of a primary level component for *Salmonids in the Classroom*.

Schoolchildren in B.C. were invited to enter a poster contest, creating designs on various appropriate themes, and over 400 of them obliged. Three of the winning entries appeared in the June issue of *Salmonid*.

Early in 1984, the *Salmonid* was named recipient of the Roderick Haig-Brown Memorial Award from the American Fisheries Society, North Pacific International Chapter for its efforts in presenting the case of the fisheries resource to the general public.

Innovation

The Small Projects Unit of SEP has long been involved with projects ranging from small hatcheries in very remote locations to public involvement projects in basements. They have been called upon to provide the biological support and engineering advice to make this wide variety of projects work. In the process, they have become uncommonly expert at creative problem-solving.

In 1983, the 16-member Small Projects team spent about 80 percent of its time in support of the expanded CEDP program. Bioreconnaissance and engineering studies were required to get the new projects started.

The team also offered support services to volunteer projects around the province, and to Field Services Branch. An independent evaluation was completed in 1983, and the program was found to have a positive benefit/cost ratio of 1.3:1.

While working on small projects in remote areas, the unit has developed a number of new and innovative approaches to fish culture and habitat improvement. Such things as using side channels, originally designed for chum spawning purposes, to provide rearing for coho; adapting aeration towers to function better in freezing conditions; using floating incubators in lakes and capturing brood stock by electroshocking are among the developments that have grown out of the team's work.

Research

Research funded by SEP, in conjunction with the Fisheries Research Branch, is concerned with both fish production methods and the impact of enhancement techniques on wild stocks.

Fish production research includes the lake enrichment program and studies to improve hatchery production results.

Lake enrichment

This is becoming one of the most successful and cost-effective production methods. Many of the results from the program over the seven years of Phase I have far exceeded expectations. Research continued in 1983, aimed at gaining increased knowledge of the most effective ways to use enrichment techniques.

A slow-release pelleted fertilizer is to be tested for use in small lakes where repeated aerial treatments over a season would be uneconomic. Muriel Lake on Vancouver Island was selected for this test, and a very complete study of its limnology and ecology was begun.

As well, changes were made in the frequency of treatment to three lakes in 1983. Hobiton, Henderson and Great Central Lakes were each treated twice weekly, and the results observed were encouraging. Preliminary findings suggest that both primary and secondary production were increased by the greater frequency.

Lake enrichment continues to offer great promise as an enhancement technique for sockeye on the west coast of North America, especially in B.C. and Alaska. The lake ecosystem is very complex; however, researchers are gradually discovering the important pathways of energy-flow, leading to increased growth and survival of juvenile sockeye in B.C. lakes.

It is felt that, over time, with the reestablishment of healthy runs of sockeye, lakes will become self-perpetuating as higher numbers of adult fish spawn, die and decay; thus enriching the environment without further human intervention.

In total, thirteen B.C. coastal lakes were enriched in 1983. Five of these, Henderson, Great Central, Kennedy, Hobiton and Nimpkish, are on Vancouver Island.

Returns to the previously-fertilized lakes were quite close to projected figures in all cases in 1983.

An unusually small-sized run of smolts from the 1982 brood year left Henderson Lake in the spring. This will provide an opportunity to compare ocean survival rates with those of larger smolts when these fish return in 1985 and 1986.

Other research

SEP-assisted research has been examining various components of hatchery production over the past seven years. By 1983, a number of

these programs were yielding results.

- nutrition studies into diet have concentrated on the development of a formula for a nutritious hatchery feed that could be produced in Canada, using Canadian raw materials. The results have been assessed, and the formula exists for commercial interests to commence manufacture
- time and size at release studies have been completed on coho and chinook, and the guidelines these have produced are now being used in production facilities. Work is being planned to commence similar studies of chum
- sex control research has yielded positive results in increasing the number of females available as brood stock. Such work is of value to production hatcheries from two aspects. First, being able to produce all-female groups of salmon would allow a hatchery to reach full capacity sooner (because of the greater number of eggs available). Experiments on the badly depleted chinook stock in the Birkenhead River indicate that this stock could be more rapidly rebuilt using this technique. As well, sterile fish can be produced which are available, for a longer period, to the commercial, sport and food fisheries because they do not mature and return to spawn
- genetics research is now being used to establish the degree of relatedness among the various upper Fraser River chinook stocks. This information will guide those who are charged with responsibility for the rebuilding of these threatened stocks in making decisions about whether they must all be handled separately or not. Studies at Quinsam are also exploring the relationship between parent and offspring sizes and are attempting to determine what, if any, differences exist between wild and hatchery stocks.

Two lower priority study areas were concluded in 1983. These were density studies, which were intended to provide accurate data for hatchery guidance, and studies to discover the determining factors in timing of smoltification.

Mark recovery

The Canadian Catch Sampling and Mark Recovery Program (MRP) was initiated in 1973 to provide observed and estimated recoveries of adipose fin-clipped, coded-wire tagged (CWT) salmonids. SEP has been a major supporter of the program for several years.

Coded-wire tagging is a cooperative Canada-U.S. project. The microscopic tags are injected into the nose cartilage of many juvenile hatchery and wild salmonids before they migrate to the ocean. The adipose fin is clipped as a visual identifier of the CWT. In 1983, over 25 million coded-wire tagged juveniles were released along the Pacific coast. When they are recovered in the commercial and sport fisheries or in escapement to the hatcheries, the tags yield valuable information on the timing, migration routes, and exploitation rate of both Canadian and American stocks. As well, tag recovery information is vital to the evaluation of SEP facilities and research projects, and for enhancement planning.

The goal of the MRP is to randomly and representatively sample 20 percent of the Canadian commercial troll and net fisheries for adipose-clipped CWT coho, chinook, and steelhead. Sampling effort is also directed at selected fisheries anticipated to contain CWT chum, pink, and sockeye, or multiple fin-clipped chum and pink salmon. In 1983, 962,200 fish were examined for marks. Of these, 556 were multiple fin-clipped and 17,728 were adipose-clipped. Sport fishermen are requested to submit heads from adipose-clipped salmonids to an extensive network of Head Depots located at DFO offices, marinas, and tackle shops. During 1983, 10,600 heads were submitted by anglers.

Table 2: SEP Expenditures by Program Area (in Thousands of Dollars)

	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84
Program Area							
Major Production Projects	$1,621	$ 6,754	$11,974	$12,847	$12,897	$ 9,715	$ 3,455
Minor Production Projects	252	726	1,098	1,461	1,212	1,211	1,188
Pilot Production Projects	283	284	135	244	181	383	211
Facility Operations/Maintenance	1,344	2,803	3,820	5,777	8,150	9,345	11,711
Community Development Projects	453	1,929	2,813	3,168	2,959	3,672	3,746
Lake Enrichment	307	676	1,095	1,345	1,454	1,801	1,874
Public Involvement	505	829	830	874	1,051	1,278	1,234
Reconnaissance/Feasibility Studies	1,581	754	1,506	1,586	990	394	305
Manageability/Environmental Studies	764	1,725	1,267	1,488	730	567	560
Evaluation/Assessment Studies	354	606	157	402	332	294	320
Research Studies	459	461	644	691	396	718	544
Program Planning and Direction	791	1,032	1,196	1,633	775	1,361	813
Provincial Program (Federal Share)	364	865	688	744	376	460	417
Provincial Program (Provincial Share)	264	289	1,243	1,250	1,250	1,250	1,250
TOTAL	$9,342	$19,735	$28,468	$33,512	$32,753	$32,449	$27,628
Source of Funds							
SEP Phase I	$7,878	$17,146	$24,735	$28,462	$26,911	$26,000	$18,800
DFO* Contribution	1,200	2,300	2,500	3,800	4,592	5,199	7,578
Provincial Share	264	289	1,243	1,250	1,250	1,250	1,250
TOTAL	$9,342	$19,735	$28,478	$33,512	$32,753	$32,449	$27,628
Phase II Program Development	—	—	—	—	$ 2,466	$ 1,496	$ 1,484

*Dept. of Fisheries and Oceans.

Table 3: Forecast Catch from Existing SEP Projects* at Design Capacity**

	Canadian Catch	
Species	**Pieces**	**Pounds**
Sockeye	3,985,127	22,809,696
Chum	1,221,453	14,162,920
Pink	471,843	2,024,374
Coho	956,147	4,810,249
Chinook	875,898	7,744,838
Steelhead	27,132	279,244
Cutthroat	14,656	7,329
TOTAL	7,552,256	51,838,650

*Projects constructed before SEP as well as SEP projects which are completed as of 1983/84 fiscal year.
**Projected Canadian commercial, sport and native food fish catches, each year.

Table 4: Summary of 1983 SEP Fish Production*

Species	**Juveniles Released**	**Expected Adult Production**
Sockeye	171,882,425	3,086,950
Chum	119,131,159	1,900,719
Pink	2,933,339	83,939
Coho	10,446,723	871,644
Chinook	25,022,718	982,299
Steelhead	2,196,244	55,845
Cutthroat	94,121	7,889
TOTAL	331,706,729	6,999,085

*Includes production from all SEP facilities and projects, and lake enrichment.

How to read Table 5:

Example: Bella Coola hatchery released 3,760,310 chum fry in 1983. These fry are expected to result in a total adult production of 75,206, of which 52,118 are expected to be caught in commercial, native food and sport fisheries. These fish will be caught or will return to the hatchery in the years 1985-1987. When the hatchery is at design ("full") capacity, it is expected to produce 102,240 adults per year, of which 70,852 per year will be caught in the various fisheries.

Table 5: Juvenile Fish Production from SEP Facilities[a] in 1983 and Adult Production at Design Capacity

Project	Type	Species	Juveniles Released	Expected Adult Production[10]	Contribution to Fisheries	Years of Return to Fishery	AT DESIGN CAPACITY Adult Production	Catch[9]
Facilities								
Bella Coola	Japanese hatchery	chum	3,760,310	75,206	52,118	1985-1987	102,240	70,852
		coho	62,758	1,255	932	1985-1986	1,300	916
		chinook	224,438	5,000	2,243	1985-1988	14,060	6,315
		steelhead	142,339[1]	1,021	684	1985-1989	900	450
Big Qualicum R.	sp. channel	chum	3,747,547	74,951	32,978	1985-1987	386,000	169,840
	hatchery	coho	1,169,263	175,389	97,967	1984-1985	340,000	189,509
	hatchery	chinook	2,799,374	83,981	58,854	1984-1987	203,000	142,855
	hatchery	steelhead	67,357[1]	1,167	584	1985-1986	2,000	1,000
	hatchery	cutthroat	5,581	446	299	1985-1986	500	335
Birkenhead	hatchery	coho					3,800	2,223
		chinook	141,535	2,405	1,969	1984-1987	5,600	4,585
Capilano R.	hatchery	coho	521,891	37,784	18,669	1984-1985	167,000	80,287
	hatchery	chinook	797,821	23,935	16,682	1984-1987	67,000	49,016
	hatchery	steelhead	58,000	1,740	870	1985-1986	760	380
Chehalis R.	hatchery	chum	8,263,950	165,279	72,731	1985-1987	201,600	87,615
		coho[2]					75,000	43,875
		chinook	683,630	20,509	14,295	1984-1987	54,000	44,215
		steelhead	82,730	2,482	1,489		5,400	3,240
		cutthroat[2]					2,400	1,608
Chemainus R.	hatchery	coho	73,421	1,101	544	1984-1985	1,000	557
		chinook	193,508	5,805	4,046	1984-1987	4,000	2,815
Chilliwack R.	hatchery	chum	4,152,553	83,102	36,116	1985-1987	60,000	26,076
		coho	118,774	22,852	13,368	1984-1986	320,000	187,200
		chinook	1,131,701	33,951	27,799	1984-1987	43,200	35,372
		steelhead	125,684	5,027	3,016	1985-1988	5,200	3,120
Eagle R.	hatchery	coho[2]					16,200	9,477
		chinook[2]					2,850	2,333
Fulton R.	sp. channel	sockeye	63,600,000	572,400	239,263	1985-1987	1,026,000	428,868
Inch Cr.	hatchery	chum	5,290,652	105,813	45,986	1985-1987	115,200	50,068
		coho	79,311	1,586	927	1984-1986	43,100	25,213
		cutthroat	25,740	2,059	1,380	1985-1986	4,000	2,680
Jones Creek	sp. channel	chum[3]					1,200	349
		pink[3]					19,800	9,428
Kalum Pilot	pilot hatchery[12]	chinook	139,935	4,198	1,536	1984-1988		
Kitimat R.	pilot hatchery[13]	chinook	291,326	8,707	5,094	1984-1988		
Kitimat	hatchery	chum[2]					158,400	118,800
		coho[2]					60,700	36,420
		chinook[2]					64,450	37,732
		steelhead[2]					1,000	500
Little Qualicum R.	sp. channel	chum	25,547,724	191,360	84,198	1985-1987	367,000	161,480
		coho					5,400	3,010
	hatchery	chinook	1,201,723	360,517	252,650	1984-1987	45,000	31,667
	hatchery •	steelhead	36,964	1,479	739	1985-1988	1,200	600
Loon	hatchery	chinook	34,400	774	634	1984-1987	3,200	2,400
Mathers Cr.	pilot hatchery[12]	chum	267,500	5,350	2,330	1985-1987	15,800	6,882
		coho	62,016	837	375	1986-1987		
Nitinat R.	Japanese hatchery	chum	8,432,138	168,643	74,203	1985-1987	340,000	149,600
	hatchery	coho	63,518	953	410	1984-1985	1,000	429
	hatchery	chinook	2,421,272	72,637	39,469	1984-1987	75,000	40,200
Pallant Cr.	Japanese hatchery	chum	3,847,537	76,951	33,520	1985-1987	152,000	66,211
		coho	447,973	8,959	4,013	1984-1988	3,200	1,434
		steelhead[14]	15,458	124	62	1985-1989		
Penny	pilot hatchery[12]	chinook	178,126	1,336	1,315	1984-1987		
Pinkut Cr.	sp. channel	sockeye	68,000,000	612,000	255,816	1985-1987	432,000	180,576
Puntledge	hatchery	chum	7,381,932	147,640	64,962	1985-1987	120,000	52,800
		pink	52,067	1,302	781	1984	10,000	6,000
		coho	933,015	139,952	78,903	1984-1985	149,000	83,050
		chinook	1,568,365	47,051	32,973	1984-1987	151,000	106,282
		steelhead	33,747	1,012	506	1985-1988	4,000	2,000
		cutthroat[2]					800	536
Quesnel R.	hatchery	chinook	1,382,880	10,373	8,493	1984-1987	51,100	41,841
Quinsam R.	hatchery	pink	2,871,272	82,357	49,414	1984	134,450	80,670
		coho	947,060	142,059	79,269	1984-1985	166,000	92,525
		chinook	1,096,347	32,890	23,049	1984-1987	90,000	63,335
		steelhead	59,900	1,798	899	1985-1986	2,000	1,000
Robertson Cr.	hatchery	coho	980,084	147,012	63,215	1983-1984	150,000	64,350
		chinook	8,526,212	225,796	121,021	1984-1987	274,000	146,864
		steelhead	434,620[1]	13,000	11,700	1984-1986	7,500	6,750
Tenderfoot/ Chesterman	hatchery	coho	112,665	16,900	8,349	1985-1986	40,500	24,745
		chinook	125,949	1,657	1,155	1984-1987	24,300	11,733
		steelhead	78,092	468	314	1986-1987	500	250
Tupana Inlet	Japanese hatchery	chum	18,796,400	375,908	165,399	1985-1987	302,000	132,880
	hatchery	coho	190,010	13,880	6,593	1984-1985	5,600	2,660
		chinook	486,900	14,577	6,647	1984-1987	43,000	19,608

Project	Type	Species	Juveniles Released	Expected Adult Production[10]	Contribution to Fisheries	Years of Return to Fishery	AT DESIGN CAPACITY Adult Production	Catch[9]
Community Development Projects								
BCIT (Seymour River)	hatchery	pink[2]					1,000	481
	hatchery	coho	111,557	10,186	5,957	1984-1986	4,657	2,725
	sea pens	chinook	1,550	465	465	1984-1987	648	531
	hatchery	steelhead	36,548	1,096	548	1985-1986	1,260	756
	hatchery	cutthroat					480	322
Bella Bella	hatchery	chum	420,000	8,400	3,696	1985-1987	33,670	23,233
		coho[2]					1,800	1,269
Chehalis Band Project	sp. channel	chum	639,756	5,118	2,252	1985-1987	9,220	4,007
	hatchery	chinook[14]	70,138	1,689	1,351	1984-1987		
Barrière	hatchery	coho[14]	25,291	607	340	1984-1986		
Cowichan R.	hatchery	chum	700,000	11,200	4,928	1985-1987	14,400	6,336
		coho	16,717	2,508	1,396	1984-1985	50,600	28,204
		chinook	224,944	5,399	4,318	1984-1987	10,800	7,600
Hartley Bay	hatchery	coho	18,047	2,030	1,137	1984-1986	8,100	4,860
Kincolith R.	hatchery	chum[2]					215	115
		coho	118,000	1,770	1,000	1984-1986	6,075	2,843
		chinook[2]					6,480	2,216
Kispiox	hatchery	coho[2]					9,117	3,652
		chinook[2]					7,182	2,629
Massot R.	incubation box	sockeye	15,120	136	77	1985-1988	790	442
		coho	60,300	2,412	946	1985-1988	9,000	3,528
	sea pens	chinook	212,000	5,088	4,070	1985-1988	6,480	3,110
Nanaimo R.	hatchery	chum	724,000	14,480	6,371	1985-1987	14,400	6,336
		coho	182,000	18,903	9,264	1984-1985	21,645	12,065
		chinook	109,880	2,637	2,110	1984-1987	10,800	7,600
		steelhead[11]	86,891	859	429	1985-1986		
Klamtu	hatchery	chum	31,167	623		1985-1987	7,200	4,990
		coho[2]					2,160	1,523
Nimpkish	hatchery	sockeye	1,712,405	28,683	16,063	1986-1987	39,500	22,120
		chum	295,339	5,906	2,717	1985-1986	10,800	4,966
		coho	9,906	446	312	1985-1986	6,750	4,725
		chinook	2,157	65	44	1985-1988	5,400	3,672
San Juan R.	incubation box	sockeye	59,400	998	608	1985-1987	360	220
		chum	2,000	16	7	1985-1987	320	141
		pink[2]					1,000	600
		coho	1,826,839	73,208	25,623	1984-1985	43,200	15,120
		chinook	150,000	4,500	2,484	1984-1987	4,990	2,754
Sechelt	hatchery	chum	38,000	760	334	1985-1987	1,620	713
		coho	17,883	2,516	908	1984-1985	7,085	2,557
	sea pens	chinook	11,242	552	404	1984-1987	12,500	9,145
Sliammon R.	Japanese hatchery	chum	1,391,000	27,820	12,240	1985-1986	20,703	9,109
	hatchery	pink[2]					1,000	740
	hatchery	coho	10,100	1,515	749	1984-1985	18,450	6,880
	hatchery	chinook[2]					540	385
Thornton Cr.	hatchery	chum	618,088	12,361	5,438	1985-1987	3,600	1,584
		coho	111,327	10,186	5,033	1984-1986	9,000	3,861
		chinook	60,849	1,825	1,272	1984-1987	7,560	4,052
Terrace	hatchery	chinook	66,000	1,320	483	1985-1986	7,920	2,899
		coho[2]					5,065	2,142
Fort St. James	hatchery	chinook	53,429	1,202	440	1985-1988	1,800	659
Small Projects								
Alouette R.	hatchery	chum	93,756	1,875	815	1985-1987	21,600	9,367
		pink[2]					40,000	19,240
		coho[2]					1,080	632
		steelhead	5,967	179	107	1985-1988	1,575	945
Copper River (Zymoetz)	box[8]	chinook	88,000	1,980	725	1985-1987		
Hemming River Obstruction	—	coho[2]					2,100	758
Hopedale Slough	side channel	chum[14]	180,990	2,534	1,115	1985-1987		
Judd Slough	side channel	chum	4,676,000	65,464	28,804	1985-1987	14,000	6,160
Louis Cr.	hatchery	coho[14]	21,774	653	490	1984-1986		
Lower Paradise	side channel	chum	1,066,400	15,210	6,692	1985-1987	4,900	2,156
McNab Cr.	side channel	chum	39,823	319	140	1985-1987	315	139
Peach Cr. Rehab.	side channel	chum	1,169,800	16,374	7,205	1986-1987	14,000	6,084
		coho[2]					150	87
Railroad Cr.	side channel	chum	636,400	8,910	3,920	1985-1987	5,600	2,464
Stream Clearance	—	coho[2]					3,000	1,310
		steelhead[2]					80	40
Upper Paradise	side channel	chum	2,693,600	37,710	16,592	1986-1987	29,400	12,936
		coho[2]					180	85

Project	Type	Species	Juveniles Released	Expected Adult Production[10]	Contribution to Fisheries	Years of Return to Fishery	AT DESIGN CAPACITY Adult Production	Catch[9]
Vancouver R.	hatchery	chum	9,854	79	35	1985-1987	16,000	7,040
		pink[3]					15,000	11,100
		coho	19,234	577	208	1985	2,400	866
		chinook					2,400	1,756
		steelhead	13,916			1985-1988	400	200
Westholme Side Channel	side channel	chum	12,853,600	179,950	79,178	1985-1987	28,000	12,320
Worth Cr.	side channel	chum	722,400	10,114	4,450	1985-1987	5,600	2,434
Provincial SEP-Funded								
Abbotsford	hatchery	steelhead	493,201	12,000	7,200	1985-1986	5,650	3,390
		cutthroat	25,400	2,340	1,200	1985-1986	5,500	3,685
Duncan	hatchery	steelhead	220,700	6,739	6,065	1984-1986	1,390	1,251
		cutthroat	29,100	2,900	1,500	1984-1986	3,500	4,050
Loon Cr.	hatchery	steelhead	157,330	3,767	2,260	1985-1986	1,200	720
Surrey	rearing pond	steelhead	39,400	1,430	858	1985-1986	400	240
		cutthroat					2,000	1,340
Lake Enrichment[4]								
Bonilla L.	fertilization	sockeye	100,000	4,500	1,764	1984-1986	43,500	17,052
Curtis L.	fertilization	sockeye	100,000	4,500	1,764	1984-1986	130,000	50,960
Great Central L.	fertilization	sockeye	16,930,000	761,850	464,729	1984-1986	1,797,000	1,096,170
Henderson L.	fertilization	sockeye	4,180,000	188,100	114,741	1984-1986	572,300	349,103
Hobiton L.	fertilization	sockeye	640,000	288,100	17,568	1984-1986	172,900	105,469
Kennedy L.	fertilization	sockeye	2,350,000	105,750	167,832	1984-1986	600,000	336,000
Klitope L.[5]	fertilization	sockeye					653,400	256,133
Lowe L.	fertilization	sockeye	80,000	3,600	1,411	1984-1986	307,600	120,579
Long Lake	fertilization	sockeye	5,920,000	148,000	82,880	1984-1986	884,100	486,255
Nimpkish L.	fertilization	sockeye	6,660,000	299,700	117,482	1984-1986	600,000	336,000
Awun L.	fertilization	sockeye[14]	580,000	26,100	14,616	1984-1986		
Eden L.	fertilization	sockeye	380,000	17,100	9,576	1984-1986	255,500	143,080
Ian L.	fertilization	sockeye[14]	560,000	25,200	1,411	1984-1986		
Yalcoun L.	fertilization	sockeye	fertilization began for 1984 releases.				100,000	56,000
Public involvement Projects[6]								
Atleo Cr.	incubation box	chum	19,000	152	67	1985-1986		
Aweisha Cr.	incubation box	chum	4,000	32	14	1985-1987		
Barriere R.	incubation box	coho	2,000	24	10	1984-1986		
Beach Cr.	incubation box	coho	10,000	380	201	1984-1985		
Bear Lk.	incubation box	coho	23,000	276	154	1984-1985		
Beaver Cr.	incubation box	coho	300	36	20	1984-1985		
Bessette Cr.	incubation box	coho	3,000	38	21	1984-1986		
B.C. Corrections Camp, Hutda	incubation box	sockeye	6,500	98	42	1985-1987		
Caledonia Jr. Sec. School	incubation box	coho	300	5	2	1984-1985		
Charlie Hardy Cr.	incubation box	chum	3,700	30	13	1985-1987		
Charlee Cr.	incubation box	chum	79,000	630	290	1985-1986		
Chilliwack R. (Chilliwack Sen. Sec. School	incubation box	coho	3,600	43	25	1984-1986		
Chilliwack R. (Center Creek Correction Camp)	incubation box	chinook	13,000	62	50	1984-1987		
		cutthroat	2,300	32	21			
Clarence Michiel School	incubation box	coho	720	11	5	1984-1985		
Courtenay & Dist. Fish & Wildlife Prot. Association	incubation box	coho	180,000	2,160	1,210	1984-1985		
		cutthroat	8,000	112	74			
Cook Cr./Blue R.	incubation box	coho	1,500	18	11	1984-1986		
Cooneikin Cr.	incubation box	coho	27,000	324	181	1984-1985		
Copper Mountain Elem. School	incubation box	coho	300	4	2	1984-1985		
Deep Cr.	incubation box	coho	10,000	120	54	1985-1986		
Deserted R.	incubation box	chum	8,300	66	29	1985-1986		
		coho	400	5	2	1984-1985		
Diana Cr.	incubation box	coho	9,000	135	57	1984-1985		
Drew Harbour Cr.	incubation box	chum	65,000	520	229	1984-1987		
Eby Street	incubation box	coho	267,000	4,305	2,411	1984-1985		
Emerson Cr.	incubation box	chinook	107,500	516	413	1984-1986		
Fairfax Cr.	incubation box	coho	22,190	266	119	1984-1986		

Project	Type	Species	Juveniles Released	Expected Adult Production[10]	Contribution to Fisheries	Years of Return to Fishery	AT DESIGN CAPACITY Adult Production	Catch[9]
Flume Cr.	incubation box	chum	2,500	20	9	1985-1986		
French Cr.	incubation box	coho	1,000	12	7	1984-1985		
Goldstream	incubation box	chum	28,300	226	99	1984-1987		
(Shawnigan Lake Boys School)	incubation box	coho	5,000	60	33	1984-1985		
Goldstream	incubation box	chinook	2,400	12	9	1984-1987		
(Amalgamated Conservation Society)	incubation box	coho	111,100	1,333	747	1984-1985		
Goldstream (Discovery Elementary)	incubation box	chum	17,000	134	59	1984-1987		
Goodspeed R.	incubation box	coho	22,500	270	128	1984-1985		
Gore Br.	incubation box	coho	19,400	232	103	1985-1986		
Hartley Bay Cr.	incubation box	coho	30,500	732	439	1984-1986		
Hastings Cr.	incubation box	coho	15,300	184	91	1984-1985		
Hyde Cr.	incubation box	chum	19,000	152	66	1985-1987		
Hyland Cr.	incubation box	coho	1,200	14	8	1984-1986		
John Howitt Elementary	incubation box	coho	4,000	48	21	1984-1985		
Kanaka Cr.	incubation box	chum	4,500	90	40	1984-1986		
		coho	1,500	225	126	1984-1986		
		steelhead	7,400	47	24	1984-1985		
Kitty Coleman Cr.	incubation box	coho	14,000	444	248	1984-1985		
Kloiya Cr.	incubation box	chinook	43,000	1,000	366	1984-1986		
Laurentian Cr.	incubation box	coho	1,000	12	7	1984-1986		
Lemieux Cr.	incubation box	coho	7,000	84	49	1984-1986		
Lions Pk.Cr.	incubation box	chum	18,000	144	63	1985-1986		
	incubation box	coho	7,000	144	71	1984-1985		
Louis Cr.	incubation box	coho	21,774	653	366	1984-1986		
Lunan Farms	incubation box	chinook	1,150	28	10	1984-1986		
Maplewood Cr.	incubation box	coho	4,000	480	281	1984-1986		
Marble R.	incubation box	chinook	200,000	6,000	4,800	1984-1987		
	incubation box	coho	10,746	157	88	1984-1985		
	incubation box	chum	2,837	57	25	1985-1987		
McKay Cr.	incubation box	coho	22,500	270	158	1984-1986		
Memekay	incubation box	coho	85,000	1,125	630	1985-1986		
Mill Bay & Dist. Conservation Soc.	incubation box	coho	19,800	238	133	1984-1985		
Millstone R.	incubation box	coho	50,000	600	335	1984-1985		
Mossom Cr.	incubation box	chum	1,000	8	4	1985-1986		
Nadu Cr.	incubation box	coho	8,000	96	43	1985-1986		
Nelson Cr.	incubation box	coho	21,000	252	147	1984-1986		
Nechako R.	incubation box	chinook	100	1	1	1984-1986		
	incubation box	sockeye	9,000	135	58	1985-1987		
Nequiltpaalis Cr.	incubation box	chum	14,500	290	128	1985-1987		
Nicola R.	incubation box	chinook	18,000	263	215	1984-1987		
Nicomeki R.	incubation box	coho	6,000	72	42	1984-1986		
Noons Cr.	incubation box	coho	16,000	2,400	1,344	1984-1985		
Oona R.	incubation box	coho	12,000	190	76	1984-1985		
Ouellette Cr.	incubation box	chum	35,000	280	123	1985-1986		
Pachena R.	incubation box	coho	35,000	420	181	1984-1985		
Port Clements El. School	incubation box	coho	120	2	1	1985-1986		
Powrivco R.	incubation box	chum	20,000	160	70	1985-1987		
Quadra Island	incubation box	chum	49,000	392	172	1984-1987		
Salmonid Enhanc. Committee	incubation box	coho	199,000	2,985	1,672	1984-1985		
Queen Charlotte Elementary/Jr. Sec. School	incubation box	coho	190	2	1	1985-1986		
Richards Cr.	incubation box	coho	25,000	300	148	1984-1985		
Robertson Cr.	keeper channels	coho	151,500	1,818	1,018	1984-1985		
Rocky Cr.	incubation box	coho	440,000	6,600	3,696	1984-1987		
	incubation box	chinook	38,450	1,154	923	1984-1985		
Rodgers Cr.	incubation box	coho	3,000	36	21	1984-1986		
Roy Cr.	incubation box	coho	20,000	240	134	1984-1985		

Project	Type	Species	Juveniles Released	Expected Adult Production[10]	Contribution to Fisheries	Years of Return to Fishery	AT DESIGN CAPACITY Adult Production	Catch[9]
Salmon R.	incubation box	coho	30,000	360	211	1984-1986		
Scott Cove	incubation box	coho	24,000	576	403	1985-1986		
Serpentine Fen	incubation box	coho	4,000	2	1	1984-1986		
Shuswap R.	incubation box	chinook	27,000	162	146	1984-1987		
	incubation box	coho	16,300	76	44	1984-1986		
Silverdale Cr.	incubation box	chum	20,000	160	70	1985-1987		
Silvermere Lk.	incubation box	chum	30,000	240	104	1985-1987		
Skeena Jr. Sec.	incubation box	coho	350	5	2	1984-1985		
Soames Cr.	incubation box	chum	7,500	60	26	1985-1986		
Sooke R.	incubation box	coho	25,500	918	321	1984-1985		
Spring Creek	incubation box	coho	20,000	240	102	1984-1985		
Stave River	incubation box	chinook	22,000	660	528	1984-1987		
Tappen Cr.	incubation box	coho	50	1	1	1984-1986		
Thornhill Elem.	incubation box	coho	340	6	3	1984-1985		
Thornton Cr.	incubation box	coho	64,700	776	435	1984-1985		
Tseax R.	incubation box	coho	32,000	384	162	1984-1985		
Uplands Elem.	incubation box	coho	680	10	4	1984-1985		
Upper Paradise	incubation box	chum	96,706	832	366	1985-1986		
		coho	64,429	720	356	1984-1985		
Vancouver Sun Classroom Incub.	incubation box	coho	8,000	96	56	1984-1986		
Wakefield Cr.	incubation box	coho	5,700	68	34	1984-1985		
Western Forest Products	incubation box	chum	75,000	600	264	1985-1987		
		coho	15,000	180	86	1984-1985		
		pink	10,000	280	168	1984		
Wilson Cr.	incubation box	chum	2,300	18	8	1985-1986		
	incubation box	coho	3,500	42	21	1984-1985		
Yalakom R.	incubation box	coho	50,000	600	351	1984-1986		
Fishways[7]								
Embley	vertical slot	pink					210,000	122,220
Kakweiken	vertical slot	pink					500,000	220,000
Koksilah	vertical slot	chum					2,000	880
	vertical slot	coho					2,000	1,115
	vertical slot	chinook					500	352
	vertical slot	steelhead					500	250
Reid	steep-pass	pink					2,000	1,164
		chinook					16,000	10,880

FOOTNOTES TO TABLE 5

*Facilities constructed before SEP as well as SEP projects.

[1] Additional releases to land-locked lakes not included.

[2] Have not yet undergone production. These species will, however, be included when the project reaches design capacity.

[3] Even year release.

[4] 1983 juvenile releases are from 1981 brood year stocks. When applied to lake enrichment, "at design capacity" figures refer to the carrying capacity of the lake.

[5] Insufficient sample.

[6] It is difficult to estimate "design capacity" due to the continually evolving nature of these projects.

[7] "At design capacity" when applied to fishways, refers to what the river will produce as a result of the fishway. Adult production is from the EPIC data base; catch is calculated using production model standards; and 1983 juvenile release and expected adult production are unavailable.

[8] Transferred to Terrace CEDP project.

[9] Catch "at design capacity" includes sport, commercial and native food catches.

[10] Survival rates vary as they are dependent upon the size of the released juveniles and the enhancement technology (i.e., released as fry or smolt, rearing times, and feeding methods).

[11] Production of the species discontinued at this facility.

[12] Pilot facility; no "at design capacity" data.

[13] Pilot facility; production capacity at this site is listed under Kitimat River. Kitimat pilot closed in 1983.

[14] Design capacity figures are unavailable.

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Director's Report

The future of SEP was the major area of interest and concern in 1983, the final year of Phase I. The most significant event of the year was government approval of the Transition Phase to run through to March 31, 1986, and the commitment to funding a continuation of the work that was established in Phase I.

There were also major achievements in the area of integration with the Pacific Region of DFO.

The appointment of SEP's director as associate director-general for the Pacific Region, the inclusion of SEP in the development of new management strategies for Pacific fisheries, the integration of finance and planning functions and closer cooperation in the communication and information area gave visible evidence of the commitment to greater integration.

The year also brought problems and challenges. Reductions in funding and in person-year allotments during the last year of Phase I created uncertainty for a period of many months in the early part of 1983. The approval of the Transition Phase was welcome confirmation of the government's faith in, and commitment to, the enhancement program.

As expected during the final year of Phase I, a great deal of time was spent planning for Phase II. These planning activities were carried out with the support and involvement of the Salmonid Enhancement Board, the Salmonid Enhancement Task Group and the Regional Planning Branch. The open information policy of SEP, and its ability to gain access to public and user group concerns were a very valuable part of this process.

With the decision to proceed with a Transition Phase rather than moving directly into Phase II, it was necessary to adjust plans to incorporate the basic elements of the Transition Phase:

- the continuation of all existing SEP operations: major facilities, lake enrichment, community economic development, public involvement, information and education programs
- evaluation of Phase I and how it has met its objectives
- closer integration with the Pacific Region of DFO
- the provision of additional funds to work with threatened chinook stocks, particularly in the upper Fraser River
- planning for a smooth and prompt shift into Phase II in 1986/87.

New projects which would require significant ongoing costs of operations beyond 1986 will be postponed until conclusion of the Transition Phase and the completion of Phase I evaluations.

Major emphasis will be placed on evaluating both the accomplishments and methods of SEP over the past seven years. This evaluation procedure is intended to assure the effectiveness of Phase II when it is launched.

Fish production, socioeconomic benefits and operating methods such as contracting-out will be closely examined during the next two years. Biologists point to the difficulty of making a firm assessment of contributions to fish production after so little time, but the early returns to the SEP facilities are encouraging. Similarly, the results from lake enrichment are viewed as successful, although it will take further time and study to assess the degree of that success.

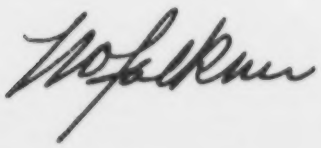
The assessment program will also

examine the nature of the interaction between hatchery and wild stocks. This issue is both complex and of significance to the future direction of the enhancement program.

The policy of contracting-out will be examined in some depth during the Transition Phase, and policies regarding the nature and extent of this method of operation will be developed before Phase II begins.

In summary, the Transition Phase is designed to ensure that future enhancement is compatible with fishery management plans. In this regard, it is encouraging to note the strengthened involvement of SEP in fisheries management policy decisions.

As the first phase of SEP concludes, there have been strong indications of success. The contribution to the sport, commercial and native fisheries appears to be substantial. There has clearly been a positive impact on many communities through CEDP and job creation programs, an impact on both employment levels and available expertise. As well, there have been very substantial benefits in the area of improved understanding between SEP, DFO and the public. Public and user groups will play an important role in the future of both SEP and the Department; the groundwork has been laid that will make that role a positive one. Over the long term, this may prove to be one of the greatest achievements of SEP, Phase I.

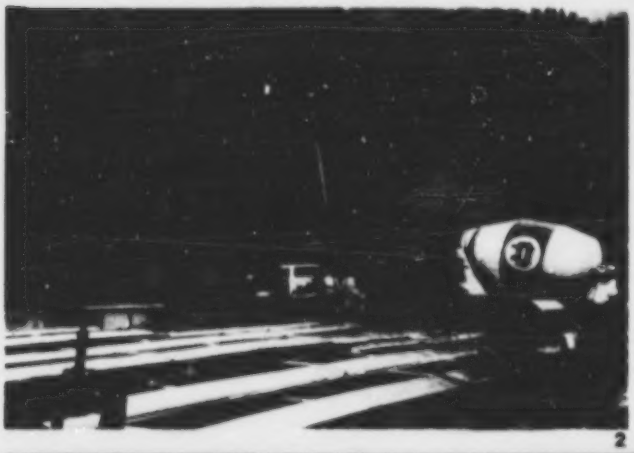


N.W. Falkner, Ph.D.
Director, SEP

South Coast

1. *The Sechelt Community Development Project at Porpoise Bay raises coho, chum and chinook.*
2. *A new aeration tower helped double the water supply at Tenderfoot Creek hatchery.*
3. *Sliammon band members clipping ventral fins of chum fry before release.*

1



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South Coast (Mainland)

Capilano Hatchery

Capilano hatchery is situated in scenic Capilano Canyon Park in North Vancouver, immediately below Cleveland Dam. It is approximately five kilometres upstream from the mouth of the Capilano River.

Hatchery Capacity and Facilities

The hatchery, when constructed in 1971, was designed to produce yearly, one million juvenile coho, 350,000 chinook and up to 65,000 steelhead trout. Subsequent modifications have increased the capacity by an additional 1.5 million juvenile chinook annually. Adult fish handling facilities at the hatchery include a river barrier, fishways, a trapping and brailing system, two Burrows-type adult holding/juvenile rearing ponds, and two circular fiberglass tubs. Juvenile facilities include ten standard Burrows ponds and thirty rearing troughs. Incubation facilities include Heath tray stacks and freestyle boxes.

Current modifications include renovations to the filter chambers below the rearing ponds for utilization as additional fish rearing areas. When completed, these renovations will provide accommodation for an additional one million fish, as well as additional area for research activities. The ability to extend the rearing of steelhead trout to two years is another benefit.

A pipeline from Capilano Lake supplies the hatchery with surface water. In addition, groundwater is provided from a network of underground tunnels in the vicinity of the east end of the Cleveland Dam. This groundwater can be heated to a temperature in excess of 20°C for the manipulation of egg development during incubation and the provision of the most ideal conditions for the initial rearing of newly-hatched fry. Because Capilano River water is generally very cold, this heated groundwater is a most valuable asset.

The hatchery complex also includes offices, laboratories, workshop and research facilities, standby generator and a public display area.

Operations

Juvenile fish releases from Capilano hatchery in 1983 numbered more than 1.5 million, made up of 537,000 coho, 808,000 chinook and 1,500 steelhead. In addition 431,000 coho fry were released into the upper watershed above Cleveland Dam. The slight reduction in the number of chinook smolts released this year should oe more than adequately compensated for by the increase in smolt size at the time of release (approximately 8 g compared to 5-6 g). The small number of steelhead released were also the first of the current practice of releasing two-year-old steelhead smolts. The coho production from the hatchery represents an average year.

Research activities carried out on production fish at the hatchery during the year included: the sterilization of coho, the production of chinook smolts of two distinct sizes, a study to measure the level of predation within the hatchery and further studies on the effects of egg disinfection.

Experiments which did not involve marked smolt releases included: a comparison of old and newly manufactured fish food in terms of fish growth and general health, erythromycin/tetracycline injections in adults for control of BKD and furunculosis, studies

relating to changes in flesh quality of adults in fresh water and in determining fish sex by mucous composition. Rearing strategies continue to be somewhat experimental in nature for all species and brood years.

Adult escapements to the hatchery for all species remained about average; coho were down somewhat from 1982 due to heavy exploitation in the river. Chinook were up from 1982, despite the exploitation and a considerable loss in the river because of poor flow conditions. The first significant return of hatchery produced summer-run steelhead was recorded in 1983.

There were more than 1.5 million chinook eggs incubated in the hatchery, 500,000 from the Capilano and more than one million from the Big Qualicum project. In addition, more than three million coho eggs were collected. Production from additional coho eggs is to bolster the local fishery during Expo 86. Significantly more steelhead eggs were collected and incubated during this year than in the past.

On two occasions during the year, high water levels in the Capilano River caused flooding inside the hatchery. In March, the high water backed up into the filter chambers, causing flooding and mixing of some groups of fish. Very few fish were killed, but some research studies were terminated as a result. In November, the highest discharge ever of water out of the Cleveland Reservoir was recorded (presumably the "one-in-two-hundred-year" flood). There was no serious loss of fish; however, some mixing did occur when the water flooded into the ponds. Modifications to the existing plumbing will be made to minimize the chances of any future flooding.

Tourist Attraction

Capilano hatchery continues to be a favorite attraction for local visitors as well as for tourists from all over the world; over 300,000 people passed through in 1983. Attractions include live fish in various stages of development, written material and displays.

Contact: Eldon Stone, Stock Enhancement Officer, Enhancement Operations; John Beyer, Senior Engineering Technician, Engineering.

Seymour River Hatchery (BCIT)

The Seymour River hatchery is located immediately below the Rice Lake Dam in North Vancouver. The B.C. Institute of Technology operates the hatchery under contract with SEP. Its objectives are to enhance Seymour River salmonid stocks and to provide a training facility for BCIT fisheries program students. They are given hands-on experience in fish culture and other enhancement techniques.

The hatchery continued its established program in 1983, working with summer and winter-run steelhead, cutthroat trout, coho and chinook stocks. Various broods of various species were coded-wire tagged again in 1983, and the hatchery provided 92,000 eyed coho eggs to volunteer projects at North Shore locations.

The hatchery provided 2.4 person-years of employment for a full-time project manager and two assistants. Provision was also made for wage supplement for a work-study program, and some labor was provided by students on a volunteer basis as part of their independent studies program.

Plans call for the continuation of the project, on the same basis, through 1984.

Contact: Chris de Hrussoczy-Wirth, Project Coordinator, Special Projects Division.

False Creek Sea Pens (BCIT)

The False Creek sea pens, which form a portion of the B.C. Institute of Technology's fisheries program, are located near Sea Village on Granville Island.

The purpose of the sea pens is to provide BCIT fisheries program students with experience in pen culture of fish. In past years, the project has also provided chinook for a very popular children's fishery at False Creek. In 1983, however, the project responded to the need for greater conservation and enhancement of threatened chinook stocks by cancelling the fishery. In late May, the 12,500 chinook juveniles were released from the pens.

In September, 5,000 1982-brood chinook juveniles, from Capilano hatchery, were ponded. This substantially reduced number was the result of only 10,000 having been allocated by the hatchery, to the CED Program, due to low escapements.

In December, 9,100 1982-brood surplus coho from Seymour River hatchery were ponded.

The BCIT projects provide benefits to the students, through the value of hands-on experience in fish culture; to the local sports fishery, through increased salmonid production in the Seymour River; and to future employers, through the increased skills and knowledge that the students acquire.

Contact: Chris de Hrussoczy-Wirth, Project Coordinator, Special Projects Division.

Indian River Feasibility

Indian River is located at the head of Indian Arm, approximately 20 km north of Port Moody. Because Indian Arm is protected from weather, is close to the population centers of the Lower Mainland and is away from shipping lanes, it often has been proposed for enhancement. Several feasibility studies have been done over the years.

A contract was let in 1983 to compile and review the data pertaining to the groundwater surveys undertaken from 1972 to 1982, the 1979/80 chinook pilot hatchery, and the 1979-81 coho sea-pen rearing operation. In view of the investment by DFO and SEP in this area to date, it was felt necessary that the rather scattered results be consolidated into a formal report. This report should be complete in 1984 and will be used to evaluate the present recommendation that the Indian River site be rejected for major production purposes.

Contact: Bruce Shepherd, New Projects Coordinator; Ted Perry, Biological Program Coordinator; Enhancement Operations.

Upper Paradise Side Channels

The first groundwater side channel on the Cheakamus River was constructed by the Small Projects Unit in 1978. Since then, ten others, in various locations, have been built. Chum is the principal species benefitting from this new technique, but increased usage by coho has been noted at several sites.

In the last two years, spawning densities at most channels have been at or above levels suggested to maximize egg-to-fry survivals (0.5 females/m^2). Because spawning densities at most channels are not manipulated, it is felt that the number of fry produced per square metre of spawning area is a better indicator of channel production than egg-to-fry survival rates.

Enumeration, in spring 1983, of Worth, Westholme, and Upper Paradise channels indicated fry outputs at 450, 700 and 800 fry/m^2 respectively. The fry production per square metre at Upper Paradise and Westholme channels was higher than from any sites previously assessed.

In summer 1983, at the instigation of the local fishery officer, one new channel was constructed on the Mamquam River near Squamish. Because the excavated material was needed for a provincial dike construction project in the area, the work was done at no cost to DFO, under the direction of Small Projects Unit staff.

There are plans to build four new channels in 1984. Assessments of all the channels will continue.

Contact: Matthew Foy,
Project Biologist,
Small Projects Unit
Special Projects Division.

Tenderfoot Creek Hatchery

The Tenderfoot Creek facility has been in full operation since the summer of 1982 and is located north of Squamish on Tenderfoot Creek. Proposed 1983/84 target figures for the hatchery were:

- chinook: 150,000 eggs
- coho: 250,000 eggs
- steelhead: 140,000 eggs.

Operations

Steelhead brood stock were obtained by angling from the Cheakamus and Ashlu Rivers. The fry were reared to approximately 0.5 g, then transported by helicopter to various locations on their rivers of origin.

The 1983 chinook brood capture was from various local rivers: Cheakamus, Squamish and its tributaries, and Ashlu. Capture was accomplished mainly by gillnetting and seining supplemented by electrofishing and angling. Trucks transported the adults back to the hatchery, where they were held until ripe, then spawned. Approximately 168,000 eggs were taken; resulting fry will be reared to smolt stage. Fifty percent of the smolts are scheduled to be clipped and tagged (CWT). Time of release evaluation will be included in the release schedule.

A helicopter survey noted very low adult chinook escapement numbers, particularly in the Cheakamus River (less than fifty spawners); consequently, all the chinook juveniles will be pooled to create a larger Tenderfoot stock.

The adult coho escapement to Tenderfoot in 1983/84 was very good, with over 4,000 fish returning (far greater than previous years). Approximately 370,000 eggs were taken from Tenderfoot Creek, Squamish and tributaries, and Mamquam River. Capture was primarily by a semipermanent trap on Tenderfoot Creek supplemented by gillnet, angling and electrofishing. Resulting fry will be returned to native rivers. Experiments comparing various Heath tray media will be carried out.

Approximately 110,000 1982-brood coho fry were released above falls on the Cheakamus River to evaluate the potential for colonization.

Future plans are for the installation of a third pumping system and aeration tower which will have a greater capacity than the existing pumps.

Additional containers will be installed for adult holding and fry rearing. As well, facility landscaping and the construction of a workshop/warehouse will be undertaken.

During the 1983 calendar year, Tenderfoot Creek hatchery operated wholly on the existing physical plant which was constructed in 1981 and enlarged in 1982. Three-phase power was brought into the site by B.C. Hydro in the earlier part of the year. In the latter half of the year, the Engineering Division began to design and prepare for construction of an additional water supply for the hatchery.

Water Supply

The present water supply for the hatchery comes from two 200 mm diameter wells, producing 47 l/sec each. This supply was more than adequate in the initial years. However, the success of the staff in obtaining stock and rearing fish exceeded expectations, straining the water supply capacity.

A third, but unused, well (300 mm diameter, and rated at 126 l/sec) existed on the hatchery site. In 1983, it was decided to connect this well and additional water supply to the present system.

Little construction work was done in 1983. Design work, plans and specifi-

cations and contract documents were drawn up in the latter part of 1983 with construction proposed for the first quarter of 1984.

The new aeration tower, with a storage capacity of 38,000 litres, will be much larger than the present one, which has a capacity of only 6,900 litres. This will give an extended emergency response time to pump failure and a greater safety margin specifically for the incubation room water supply.

Power Supply

The original power supply to the site was single phase. This posed major problems in operating the water supply pumps and other major pieces of equipment. Phase converter equipment was used but caused unnecessary complications, hence the initiation and completion of the conversion to direct three-phase power.

Expansion Plans

The facility will be enlarged to almost double its present size in 1985. Reconnaissance and survey work will be carried out in 1984 to establish design parameters for this expanded facility. Prime among these is the feasibility of utilizing surface water supply from either the Cheakamus River or Brohm Lake. Final design should commence in late 1984 with a tender package completed by March 1985. Construction will occur in the 1985/86 fiscal year.

Contact: Bill Foye, Stock Enhancement Officer, Enhancement Operations; Ian Ross, Project Engineer, Engineering.

Sechelt Community Development Project

The Sechelt Indian Band operates this project in Porpoise Bay, near the village of Sechelt. The objective of the project is to enhance coho sport, commercial and native food fisheries in Sechelt Inlet and to increase chum stocks in local streams.

In 1983, four Band members were employed full-time at the sea-pen facility and the new hatchery building. They also upgraded their fish culture and management skills at specialized courses offered through Malaspina College and the Community Development Unit of SEP's Special Projects Division.

In spring 1983, 250 chinook fry and 40,000 chum fry from the 1982 brood were released from the hatchery. In addition, 4,362 coho from 1981 and 1982 Sechelt broods were released from the sea pens.

The project also released 10,742 Capilano chinook (1981 brood) and 13,521 coho in June.

Brood stock was collected by purse seining adjacent to the sea pens. The following eggs were collected:

- chum; 49,151 from wild stock
- chinook; 10,342 from Capilano/ Sechelt returnees
- coho; 42,560 from Capilano/ Sechelt returnees
- coho; 57,918 from local wild stock.

Other activities in 1983 included a Petersen disc adult tagging and release program. As part of the brood stock collection, they helped estimate population and distributions of wild stock and hatchery returnees. Hatchery operations procedures and strategies were developed for the next two years. Differential size releases and multiple tag groups will help to assess optimum conditions.

Construction during the year included the building of a dock at the hatchery site for access to the sea pens, subcontracting for the construction of a hatchery building, site access development and installation of hydro and telephone as well as work on the water supply system. New sea pens will be installed to accommodate 100,000 coho for the Expo 86 fishery.

Contact: Maurice Boisvert, Project Coordinator, Special Projects Division.

Powell River Salmon Society

This was the first full year of operations for the four staff of the Powell River Salmon Society. This project is funded through the federal Special Employment Initiative Program and operated under contract to the Community Economic Development Unit of the Special Projects Division of SEP.

The main objectives are to enhance natural runs of coho (and possibly chinook and steelhead in the future) to historic levels, to improve sport fishing in the area and to develop and promote public awareness for the program and the salmon resource. To this end, four full-time staff were hired by the Society to train in the art of fish culture and to begin construction of a hatchery facility on Lang Creek. A river intake, pipeline, hatchery building and effluent settling pond were constructed in 1983. The hatchery building consists of a work/storage area, incubation room with Heath trays, office, and outdoor rearing area. The staff also fabricated their own fiberglass rearing troughs. Site access was improved as well.

The Society succeeded in obtaining additional funding through a Canada Works job creation program. This enabled various site improvements and the construction of a concrete raceway for adult holding and additional juvenile rearing.

Society staff also produced detailed habitat maps of five local streams and completed stream improvements in them to facilitate adult passage wherever possible. A monitoring program on these systems has provided valuable information on flows, water levels and temperature throughout the year. The carrying capacities of these systems were also evaluated.

In 1983, the Society staff obtained 36,601 Lang Creek coho eggs and 7,737 Kelly Creek coho eggs. An additional 4,295 eggs were transported from the Whittal Creek public involvement project to the Lang Creek hatchery after flooding damaged the water delivery system at Whittal Creek.

In 1984, the Society will construct a brood stock collection facility on Lang Creek and will evaluate population size and spawner escapements. They will finish construction of the hatchery building and build three more fiberglass rearing troughs. 1983 brood coho will be reared at the hatchery to 3-5 grams and released to Haslam Lake. An extensive downstream trapping program and periodic lake sampling will help provide information to evaluate the most appropriate size and time of release and of future enhancement strategies for Lang Creek coho. The Society will continue to update the stream habitat maps and identify and proceed with additional stream improvements. By September 1984, the facility should have an incubation capacity of 500,000 eggs.

Contact: Maurice Boisvert, Project Coordinator, Special Projects Division.

Sliammon Hatchery

Five members of the Sliammon Indian Band have operated this Japanese-style hatchery since 1977. Located on the Sliammon River, eight kilometres north of Powell River, the project is designed to enhance existing stocks of chum and coho in the Sliammon River and to train and employ selected Band members in fish culture and management.

In 1983, hatchery staff released approximately 1.4 million chum salmon fry (average size, 1 gram) and reared approximately 30,000 coho fry due for release in February 1984.

The staff completed the following additional activities:

- a river water supply line was extended from the rearing channels to the rearing tubs
- river bank stabilization, boulder placement and instream gravel relocation on the Sliammon River between the new river intake and the brood stock

collection fence was completed
- the access road was improved
- landscaping and grass seeding were done
- modifications to the brood stock collection fence were completed
- downstream migration timing assessment and sampling for chum were done
- 1.1 million chum and 78,000 coho eggs were collected and incubated
- adult coho and chum were enumerated and a mark recapture study was conducted
- an Okeover Inlet sea-pen rearing project study was undertaken, including monitoring and assessment of physical parameters
- a boat storage shed, sea-pen floats for Okeover inlet coho rearing and a flow control weir at the outlet of Sliammon Lake were constructed using job creation program funding.

The crew will release the 1982 brood coho smolts to Sliammon Lake in February 1984 and the 1983 brood chum in May. Future plans include:
- rearing of approximately 60,000 1983 brood coho fry for eventual release to Sliammon Lake and River
- transfer of 100,000 coho from Capilano hatchery to Okeover Inlet for rearing to May 1985 to improve sport fishing opportunities during Expo 86
- transfer of 50,000 each of chinook and coho eggs from Big Qualicum hatchery for eventual rearing and release at Okeover Inlet
- brood stock collection and incubation of 75,000 Sliammon River coho eggs and 1.1 million chum eggs
- adult enumeration studies on the Sliammon River
- water delivery improvements and modifications to reduce the risk of supersaturation
- continued modification of the brood stock collection fence.

Plans in 1984 for Okeover Inlet sea-pen development include stream monitoring, downstream trapping, brood stock collection, incubation, rearing and development of a freshwater delivery system to the sea pens.

Contact: Maurice Boisvert, Project Coordinator, Special Projects Division.

Vancouver Bay Project

The Vancouver Bay hatchery, a joint project of DFO and B.C. Forest Products, is situated on Jitko Creek, a tributary of the Vancouver River. The hatchery was designed to enhance depleted chum and pink salmon stocks in the area. Small numbers of coho, steelhead and chinook are also being enhanced.

In June, 10,000 chum fry were released at 0.8 g into Jitko Creek, and 20,274 coho fry and 14,750 steelhead fry were released in October by helicopter into the Vancouver system. Egg-takes involved the transplant of Squakwa pink, Saltery Bay chum and 21,000 Capilano chinook eggs. Currently, 108,000 Vancouver River coho eggs are incubating at the hatchery. Fifty thousand Vancouver River steelhead eggs are to be incubated in the spring of 1984.

Contact: Kim West,
Biologist,
Special Projects Division.

Mainland Inlet Reconnaissance

A great deal of valuable reconnaissance work was done on various mainland inlet rivers in 1983. The purpose of all the work was to become familiar with the natural features of each river system and to gather physical data necessary for the design of salmonid enhancement projects.

Some of the types of data gathered include:
- aerial photography: gives the shape of rivers, streams and landforms and provides the basis for all engineering design on the site
- surveying: results in detailed topographic plots of specific areas
- soil testing: usually done with a tracked excavator; yields valuable in-

formation about subsurface soil conditions and water table elevations that will be encountered in future construction

- raw materials exploration: all construction work requires quantities of rock for bank protection, gravel for site fill, sources of spawning gravel for channels and clay for dam cores
- metering and hydrology: an essential part of any design is the knowledge of existing and potential flows. Prediction of flood flow, low flow and stage using hydrological methods applied to river metering data is a crucial element of all facilities
- access: the means of getting to the site is an important consideration; often logging roads built in the past can be rehabilitated, sometimes new roads and bridges must be built
- local information: often invaluable local information is available from the inhabitants, loggers and aircraft photos regarding natural conditions likely to be found in the area
- preliminary designs: many preliminary designs including quantity calculations and cost estimates are done prior to the selection of the optimum layout. Each scheme is carefully scrutinized for practicality and minimum cost, resulting in the best overall level design.

Some of the rivers with interesting possibilities examined in 1983 were Southgate and Orford in Bute Inlet, two sites on the Phillips River near Loughborough Inlet, the Ahnuhati River and Devereux Creek in the Knight Inlet area and the Kakweiken River in Thompson Sound.

Plans for 1984 call for a small pilot hatchery on Devereux Creek using both Devereux and Ahnuhati chinook brood stock, plus a flow control structure and spawning channel on the lower reach of the Phillips.

Future plans call for enlargement of the existing data base through additional gathering of river flow, soil and weather information.

Contact: George Nielsen, Senior Project Engineer, Engineering.

Knight Inlet Reconnaissance

Knight Inlet is approximately 75 km north of Campbell River and has been proposed for a major enhancement effort. Biophysical and spawner reconnaissance studies of several Knight Inlet streams were carried out by consultants in 1981. During 1983, additional contracted studies were undertaken. Fry migration in the Tom Browne and Glendale systems was monitored in the spring. The fry migration data were combined with water temperature data and available plankton survey information in a draft report which examined the possibility of overly premature emergence of pink fry if Tom Browne Lake water was used to supply a spawning channel. It was tentatively concluded that pink fry migration would be advanced, but not to the extent that survival would be reduced. Spawner and biophysical surveys were repeated in 1983; the Franklin River was deleted and the upper Klinaklini system was added to the surveys on the basis of the 1981 results. The final report will estimate spawning and rearing capacities for each species and system. Water temperature and quality continued to be monitored on the Devereux and Tom Browne/Glendale systems. It is planned to contract further juvenile migration and rearing studies of the Klinaklini/Devereux, Tom Browne/Glendale, and Ahnuhati systems in the spring of 1984.

Contact: Bruce Shepherd, New Projects Coordinator, Enhancement Operations.

Devereux Creek Pilot Project

Reconnaissance (see the Knight Inlet report) identified a potential facility site located on Devereux Creek, which is a tributary of the Klinaklini River, just at the head of Knight Inlet. A

disease survey also done as part of reconnaissance revealed the presence of the viral disease IHN (infectious hematopoietic necrosis) in kokanee in the Devereux system. Although the disease has caused severe mortality in chinook at U.S. hatcheries, it is questionable whether this will occur at Devereux. For example, the Robertson Creek hatchery has been extremely successful in producing chinook, yet draws water from a system supporting IHN-infected sockeye. Therefore it was felt that a pilot was required to investigate whether Devereux or Ahnuhati chinook will pick up the disease under culture conditions. It is proposed that the pilot consist of two main components. First, experimental lots of eggs and alevins will be deliberately exposed to known levels of the IHN virus to gauge susceptibility. Second, tag-size groups (100,000-250,000 eggs) of the two chinook stocks will be reared on the proposed lake water supply using production fish culture techniques.

A considerable amount of engineering investigation was performed in 1983 to confirm the feasibility of this site. The outstanding feature of the Devereux system is the presence of a plentiful supply of lake water to provide a continuous flow of water to the pilot hatchery. In fact, an extension of the pipeline down the hill could result in the feasibility of generating hydro power with a small water turbine, thus eliminating the need for diesel power generation.

Engineering site work consisted of an aerial photographic survey, soil investigation, site surveying and river metering. Design work on the pilot hatchery is currently underway, with construction planned for completion by September 1984.

Contact: Bruce Shepherd, New Projects Coordinator, Enhancement Operations; Roy McGechaen, Senior Project Engineer, Engineering.

Embley River Gravel Addition

Embley River is located 10 km northwest of Sullivan Bay on the mainland.

Embley River has a low-flow problem for spawner access which has been corrected with a fishway. The river is protected from floods by a large logjam at its outlet in Huaskin Lake and another unobstructed outlet which dumps all the high flows. In general the river has poor gravel and onsite gravel recruitment is not possible. The objective was to provide additional and improved spawning gravel for coho and pink salmon.

Approximately 1,100 tonnes of screened spawning gravel was barged to Embley lagoon and placed by an Okanagan Sikorsky helicopter. The work took about five days. The gravel created approximately 3,200 m^2 of new spawning area. Local fishery officers viewed the area in the fall and observed coho spawning in the new gravel.

This new method of improving gravel compares very favorably in cost with improved side channels and spawning channels. It may be a method of enhancing stocks where access is limited and where providing access up the river would cause serious harm to the resource.

The even-year run of pink salmon is dominant; 1984 spawning activity is to be observed by SEP reconnaissance staff and fishery officers to evaluate the value of this approach.

Increased survival of the few remaining Embley River pink salmon would be the benefit from this project. Eventually, if this stock is rehabilitated, it could contribute to the commercial fishery.

Contact: Jim Wild, Senior Implementation Engineer, Engineering.

Provincial Status Report

Steelhead and sea-run cutthroat enhancement activities continued in 1983, with a number of highlights occurring.

Tenderfoot Creek hatchery initiated its steelhead program by holding wild Cheakamus and Squamish origin brood stock. Fry from these fish were outplanted to the Cheakamus River and Ashlu Creek in August. The provincial Fraser Valley trout hatchery at Abbotsford, using Squamish River brood stock, provided additional fry for release into Ashlu and Shovelnose Creeks on the upper Squamish River. Steelhead anglers helped provincial fisheries staff considerably during the capture of steelhead brood stock for these hatchery programs.

Angling on the Squamish River system was under its first full season of a wild steelhead release harvest regulation. Angler effort during the (1982/83) season on the Squamish watershed (Cheakamus, Squamish and Mamquam Rivers) was down by 38 percent over the previous year. Total catch and catch success also decreased considerably. These changes were due to the new harvest regulations and to poor returns of steelhead. Regulations and the hatchery fry stocking program will result in much improved fish numbers and angling over the next few years.

Contact: Peter Caverhill, Regional Fisheries Biologist, Fish and Wildlife Branch, Surrey.

Job Creation Projects

Seymour River Project

Ten people were employed on this project located on the Seymour River, which flows south into Burrard Inlet, in North Vancouver. A sport fish creel census provided needed information for management of the steelhead fishery, while trail upgrading improved access for anglers and Seymour River hatchery personnel.

Cypress Creek Intake Restoration

The goal of this project was to restore the Cypress Creek water intake system to provide fresh water at ambient temperature for the experimental fish culture facilities at the West Vancouver Laboratory. The 14 workers were involved in:

- reinstalling the pipeline to the intake below scour depth in the riverbed
- modifying the existing concrete infiltration structure to incorporate an inclined screen intake
- installing gabions to reduce further scouring around the settling chamber
- removing riverbed deposits from screens after major increases in water flows.

Juvenile Salmonid Use of Estuaries

Ten people were employed on this project at the West Vancouver Laboratory. The project had five main goals:

- to design and test apparatus which simulates natural estuarine environmental conditions by allowing stratification of the water column into three distinct layers
- to provide information on juvenile salmonid behavior in the test apparatus under various experimental conditions
- to provide information on effects of various pollutants in the test apparatus on the behavior of juvenile salmonids
- to establish food web components of the Campbell River estuary in Surrey
- to analyse data and research relevant literature for inclusion in reports.

This project is an ongoing study; as results come in, more should be understood of juvenile salmonid use of estuaries and the consequences of displacing salmonids from these habitats.

Effects of Habitat Change in Estuaries

Fourteen project workers set out to study the potential effects of habitat changes on juvenile salmonid stocks in the Campbell and Fraser River estuaries. Working at the West Vancouver Laboratory, they set up testing apparatus and obtained data on the distribu-

tion of juvenile salmonids in the two estuaries.

Fish Culture Research Support

Twenty-four project workers provided support for ongoing research of the controlled reproduction and nutrition programs within the fish culture section of the Fisheries Research Branch.

They processed data from fish culture experiments to obtain statistical comparisons, and assisted in:

- experiments related to the short and long-term cryopreservation of salmon gametes
- radioimmunoassays and other duties related to the determination of maturational processes in Pacific salmon
- various office duties including filing and typing
- experiments related to the development of diets for juvenile salmonids
- experiments in the area of controlled sex differentiation of trout
- experiments in the area of controlled reproduction of salmon
- the purification and bioassay of fish pituitary hormones
- the operation and maintenance of the West Vancouver Laboratory.

Landed Quality of Fish

The goal of this project, located at the Fisheries Technology Research Laboratory at the University of B.C., was to improve the landed quality of fish.

The five employees prepared fish samples for chemical, biochemical and bacteriological testing. They participated in testing various organs of fish and prepared the work areas and equipment used in fish preservation trials.

Iona Island Sewage Treatment Plant

This project set out to determine the effects that wastes discharged from Iona Island sewage treatment plant have on salmon and their habitat.

The five project workers aided researchers at the West Vancouver Laboratory in the design, construction and operation of laboratory exposure systems and apparatus to observe behaviour of salmon in a water column.

They prepared water, effluent and salmonid tissue samples for analysis and studied the effects of contaminants on detoxification enzyme systems. The fish were collected in the area of the Iona sewage plant.

Microfilming Historical Documents

The three people in this project microfilmed approximately 300,000 licencing documents covering the period 1968 - 1983, indexed 600,000 original documents for archive storage, and indexed developed microfilm for ready retrieval.

Inventory Audits

The five project employees performed physical inventory verification audits of items at various DFO operations, including laboratories, hatcheries, field camps, warehouses and general offices.

They compared their findings with DFO records and checked manual records against a new computerized system.

Assessment of Radio Proceedings

The five staff of this project monitored DFO radio telephone transmissions for corrections, strength, readability, and procedures.

Vancouver Inspection Laboratory

This project, to be completed in March 1984, employs 16 people to accomplish the following goals:

- to compile in manuals; reference procedures, guidelines and standards regarding final product grade standards
- to evaluate canned fish for the presence of can defects in compliance with quality control programs in fish plants
- to evaluate data base information from salmon canneries regarding can screening performance
- to evaluate the performance of new can integrity apparatus developed under government control
- to compile information regarding export certification and to input these data on computer
- to convert the present filing system to a uniform numbering system as suggested by the Records Management Directorate.

"The Sun" Save The Salmon Society

"The Sun" newspaper sponsored a number of projects for students throughout the province. On the Lower Mainland three teams of five students worked on a number of projects:

- stream clearance and gravel placement in a small Langley stream
- installation of the water system for Kanaka Creek hatchery; bank restoration and reseeding of cleared site
- fry planting in Stoney Creek
- brood stock capture at Squamish
- removal of debris from fishways in West Vancouver streams
- restoration of banks and improving spawning areas in Bear Creek.

Students were also busy in other parts of the province. At Smithers four students cleared and enhanced a slough on land adjacent to the Bulkley River. In Kamloops, three high schoolers built a 250,000-egg capacity hatchery for coho at Louis Creek. And on Quadra Island, three students helped dig a spawning channel at Hyacinthe Bay Creek.

Squamish Salmonid Enhancement Project

Under the supervision of DFO staff in the Squamish subdistrict, a crew of four conducted a reconnaissance study and inventory of salmonid enhancement potential of several watersheds in the area. This project was undertaken in preparation for the future development of several small community-oriented enhancement projects.

Lang Creek Hatchery Site

The four employees of this project landscaped the Lang Creek hatchery site. Their activities included:

- burning stumps and other debris
- channeling the hatchery outfall
- constructing a concrete raceway and a wood-framed shelter in the outfall
- erecting an entry gate
- building an observatory platform and access path beside the falls
- backfilling the pipeline route
- planting indigenous trees and shrubs to prevent erosion and enhance the hatchery setting.

Surrey Fisheries Enforcement

The five employees of this project assisted DFO fishery officers and clerical staff in the Surrey area. Their activities included:

- patrolling to observe, record and report Fisheries Act violations and development activities
- investigating complaints and identifying valid ones for fishery officer action
- observing work affecting fish habitat and reporting on it to a fishery officer
- conducting various creel censuses.

Little Campbell River Project

This project located on the Little Campbell River in Surrey provided labor, materials and machine time to aid in the completion of the Semiahmoo Fish and Game Club hatchery.

The 17 workers were involved in:

- installation of complete septic system
- completion of hatchery building with incubation, rearing, classroom, washroom and storage facilities
- installation of water distribution system including two aeration towers, a filter, alarms and two wells with pumps
- excavation of a holding pond and dike
- development of outdoor classroom/picnic area
- construction of a salmonid nature trail
- cleanup of urban debris from the river.

Contact: Colin Masson, Project Coordinator, Special Projects Division.

SOUTH COAST PUBLIC PARTICIPATION PROJECTS

Location	Name of Group	No. of People Involved in 1983	No. of Years Group Involved In SEP	Type of Project	Species	Juveniles Released	% Survival	Expected Adult Production from 1983 Releases
Richards Creek	Buntzen Bay Residents Association	6	4	incubation, feeding	coho	25,000	02	300
North Vancouver Area Creeks	The Sun/North Vancouver School District	3,000	3	incubation in school	coho	12,000 Transplant from Capilano hatchery.	47	145
McKay Creek	North Shore Fish & Game Club	20	4	stream improvement, fishways	coho	22,500	90	270
McCartney Creek	Seymour Heights Elementary/Windsor Secondary Schools	40	2	incubation	coho	Eggs killed due to vandalism.		
Noons Creek	Brian Waite	4	5	incubation, feeding	coho	24,000	80	720
West Vancouver Area Creeks	The Sun/West Vancouver School District	200	3	incubation	coho	24,000 Break in waterline killed about 12,000 eggs.	37	288
Hastings Creek	Squaretailers Rod & Reel Club	12	7	incubation, stream improvement, fishways	coho	300 Prehatch mortality due to poor water quality.	1	4
Cheakamus R./ Upper Paradise Channel	The Sun/North Shore Outdoor School	3,000	3	incubation, rearing	chum coho	104,000 60,000	97 82	832 1,800
Hyde Creek	George Pearkes Secondary School	90	5	incubation, stream improvement	chum	19,000	76	152
Laurentian Creek	Montgomery Junior Secondary School	40	5	studies, incubation in school, information	coho	1,000	17	12

Contact: Gary Taccogna, SEP Community Advisor.

Table 1

Public Participation Projects

SOUTH COAST PUBLIC PARTICIPATION PROJECTS

Location	Name of Group	No. of People Involved in 1983	No. of Years Group Involved In SEP	Type of Project	Species	Juveniles Released	% Survival	Expected Adult Production from 1983 Releases
Roberts Creek	Roberts Creek Elementary School	75	1	rearing	coho	25	25	-
Wilson Creek	Gibsons Wildlife Club	20	5	incubation, rearing	coho	3,500	54	42
					chum	2,300	66	18
Soames Creek	Granthams Wharf Rec. Association	15	3	incubation	chum	7,500	99	60
Quellette Creek	L & K Lumber Ltd.	20	6	incubation	chum	35,000	99	280
Wakefield Creek/ Flume Creek	Sechelt Rod & Gun Club	10	5	incubation	coho	5,700	95	68
					chum	2,500	99	20
Lions Park Creek	Pender Harbor Wildlife Society	20	5	incubation, rearing, feeding	chum	18,000	95	144
					coho	7,000	99	144
Deserted River	Native Environmental Studies School	25	4	incubation	chum	8,300	42	66
					coho	400	6	5

Contact: Grant McBain, SEP Community Advisor.

Location	Name of Group	No. of People Involved in 1983	No. of Years Group Involved In SEP	Type of Project	Species	Juveniles Released	% Survival	Expected Adult Production from 1983 Releases
Scott Cove River	Broughton-Gilford Island Project	40	2	hatchery	coho	24,000 Fry obtained from downstream trapping; 14,007 were tagged.	90	576

Contact: George Bates, SEP Community Advisor.

Table 2

South Coast SEP Facilities*: Juvenile Releases 1983

Species	Brood	Group	Total Released	% Marked	% Survival	Average Size(g)
Capilano Hatchery						
Chinook	1982	Big Qualicum	177,685	45	N/A	8.20
Chinook	1982	Big Qualicum	147,088	35	N/A	7.54
Chinook	1982	Capilano	164,226	23	N/A	7.51
Chinook	1982	Capilano	158,694	25	N/A	9.64
Coho	1981	Big Qualicum	150,128	33	N/A	7.92
Coho	1981	Capilano	71,242	8	N/A	16.51
Coho	1981	Capilano	78,905	89	N/A	18.94
Coho	1981	Capilano	60,987	9	N/A	17.57
Coho	1981	Capilano	57,115	34	N/A	17.66
Coho	1981	Capilano	44,038	33	N/A	15.18
Coho	1981	Capilano	140,128	12	N/A	13.95
Coho	1982	Capilano	69,476	40	N/A	21.23
Coho	1982	Capilano	120,031	0	N/A	0.41
Steelhead	1981	Capilano	310,733	0	N/A	1.75
Steelhead	1983	Capilano	1,466	64	N/A	95.0
			42,577	0	N/A	1.76
Seymour River Hatchery						
Chinook	1981	Cap./False Crk.	3,000	100	N/A	40.0
Chinook	1982	Cap./False Crk.	12,500	100	N/A	100.0
Coho	1982	Seymour	105,800	N/A	N/A	1.0
Steelhead	1981	Seymour	14,500	47	N/A	100.0
Steelhead	1982	Seymour	10,500	0	N/A	6.0
Steelhead	1982	Seymour	2,400	100	N/A	20.0
Steelhead	1983	Seymour	16,700	0	N/A	2.0
Tenderfoot Creek Hatchery						
Chinook	1982	Cheakamus	24,744	95	N/A	1.7
Chinook	1982	Squamish	28,565	96	N/A	1.9
Chinook	1982	Squamish	24,603	90	N/A	3.0
Chinook	1982	Ashlu	25,158	80	N/A	1.9
Chinook	1982	Ashlu	22,879	84	N/A	3.1
Coho	1982	Shovelnose	45,198	0	N/A	1.6
Steelhead	1983	Cheakamus	22,011	0	N/A	.30
Steelhead	1983	Squamish	56,781	0	N/A	.35
Sechelt Community Development Project						
Chinook	1981	Capilano/Sechelt	10,742	100	54	88.0
Chinook	1982	Sechelt	239	0	15	1.0
Chum	1982	Sechelt area streams	38,000	0	53	1.0
Coho	1981	Sechelt	3,131	100	27	30.0
Coho	1981	Capilano/Sechelt	13,521	100	73	30.0
Coho	1982	Sechelt	1,231	0	26	28.0
Vancouver Bay Project						
Chum	1982	Vanc. R.	10,000	0	67	0.8
Coho	1982	Vanc. R.	20,274	0	75	8.0
Steelhead	1983	Vanc. R.	14,750	0	78	3.0
Sliammon Hatchery						
Chum	1982	Sliammon	1,391,000	0	88	1.49

*Includes facilities constructed prior to SEP.
N/A means "not available."

Table 3

South Coast SEP Facilities*: Status at December 1983

Species	Stock	Brood	Stage	No. on Hand	Expected Release Date	Number	Site
Capilano Hatchery							
Chinook	Capilano	83	egg	554,000	N/A	N/A	Capilano
Chinook	Capilano	82	yearling	850	N/A	N/A	Capilano
Chinook	Big Qualicum	83	egg	1,112,500	N/A	N/A	Capilano
Coho	Capilano	83	egg	2,516,000	N/A	N/A	Capilano
Coho	Capilano	82	fry	594,400	N/A	N/A	Capilano
Steelhead	summer run	83	fry	41,200	N/A	N/A	Capilano
Steelhead	summer run	82	yearling	14,200	N/A	N/A	Capilano
Steelhead	winter run	83	fry	3,026	N/A	N/A	Capilano
Seymour River Hatchery							
Chinook	Cap./False Ck.	82	smolt	5,100	N/A	N/A	False Creek
Chinook	Seymour	83	egg	5,000	N/A	N/A	False Creek
Coho	Seymour	82	smolt	21,750	N/A	N/A	Seymour
Coho	Seymour/ False Crk.	82	smolt	9,100	N/A	N/A	False Creek
Coho	Seymour	83	egg	320,000	N/A	N/A	Seymour
Cutthroat	Seymour	83	fry	1,000	N/A	N/A	Seymour
Steelhead	winter run	82	presmolt	29,200	N/A	N/A	Seymour
Steelhead	winter run	83	fry	24,500	N/A	N/A	Seymour
Steelhead	summer run	83	fry	15,100	N/A	N/A	Seymour
Tenderfoot Creek Hatchery							
Chinook	Tenderfoot	83	alevin	167,000	May-June 1984	143,000	Tenderfoot
Coho	Tenderfoot	83	adult	180	for brood stock		
Coho	Mamquam	83	adult	101	for brood stock		
Coho	Squamish	82	presmolt	52,300	June 1984	52,000	Squamish
Coho	Tenderfoot	82	presmolt	50,000	May-June 1984	42,000	Tenderfoot
Secheit Community Development Project							
Chinook	Capilano	82	smolt	2,532	June 1984	2,500	sea pens
Chinook	Porpoise Bay	83	egg	10,342	June 1985	9,000	sea pens
Chum	Porpoise Bay	83	egg	49,478	April 1984	47,000	local creeks
Coho	Porpoise Bay	83	egg	100,478	through 1984	87,000	creeks/ sea pens
Vancouver Bay Project							
Chinook	Capilano	83	egg	21,465	July 1984	19,000	Jitco
Chum	Jitco	83	egg	43,894	May 1984	32,000	Jitco
Chum	Jitco/Saltery	83	egg	7,880	May 1984	1,900	Jitco
Chum	Saltery	83	egg	34,336	May 1984	17,000	Jitco
Coho	Jitco	83	egg	108,385	Sept. 1984	96,000	Vancouver system
Pink	Jitco	83	egg	64,400	March 1984	50,000	Jitco
Pink	Jitco/Skuakwa	83	egg	226,175	March 1984	200,000	Jitco

Table 3 (Cont'd)

South Coast SEP Facilities*: Status at December 1983

Species	Stock	Brood	Stage	No. on Hand	Expected Release Date	Number	Site
Powell River Salmon Society							
Coho	Lang Creek	83	egg	36,601	July 1984	36,000	Haslam Lk.
Coho	Kelly Creek	83	egg	4,297	Sept. 1984	4,000	Kelly Crk.
Coho	Whittal Creek	83	egg	4,295	April 1984	4,000	Whittal Crk.
Pink	Lang Creek	83	egg	874	March 1984	750	Lang Crk.
Sliammon Hatchery							
Coho	Sliammon	82	presmolt	7,000	Feb. 1984	6,900	Sliammon Lk.
Coho	Sliammon	83	egg	78,347	May 1985	30,000	Sliammon Lk.
						30,000	Sliammon R.
Chum	Sliammon	83	egg	1,113,200	May 1984	1,000,000	Sliammon R.
Pink	Sliammon	83	egg	10,148	March 1984	10,000	Sliammon R.

*Includes facilities constructed prior to SEP.
N/A means "not available."

Table 4

South Coast SEP Facilities: Surplus Sales 1983*

Species	Amount of Fish (kg)	Eggs (number)	Native Food Fish (pieces)	Value ($)
Capilano Hatchery				
Coho	16,711.12	0	0	15,388.20
Chinook	453.60	0	0	158.76
Mixed[1]	10,132.30	0	0	303.97
Coho	0	77,300	0	--
Coho	0	75,000	0	10.50

*Includes facilities constructed prior to SEP.
[1]Coho and chinook sold together.

Table 5

South Coast SEP Facilities*: Escapement to Facility 1983

Species	Escapement to Facility	Spawned for Hatchery Stock male	Spawned for Hatchery Stock female	% Marked male and female
Seymour River Hatchery				
Coho	10,000	--	177	0
Chinook	--	--	1	0
Cutthroat	--	--	4	0
Steelhead (winter run)	--	--	11	0
Steelhead (summer run)	--	--	9	0
Tenderfoot Creek Hatchery				
Chinook	234	38	29	0
Steelhead (Squamish)	27	17	10	0
Steelhead (Cheakamus)	20	12	8	0
Coho (Tenderfoot)	4,650	106	86	0
Coho (Mamquam)	130	23	22	0
Sliammon Hatchery				
Not available at time of printing.				
Sechelt Community Development Project				
Not available at time of printing.				
Capilano Hatchery				
Not available at time of printing.				

*Includes facilities constructed prior to SEP.

Table 6

South Coast SEP Facilities: Adult Production*

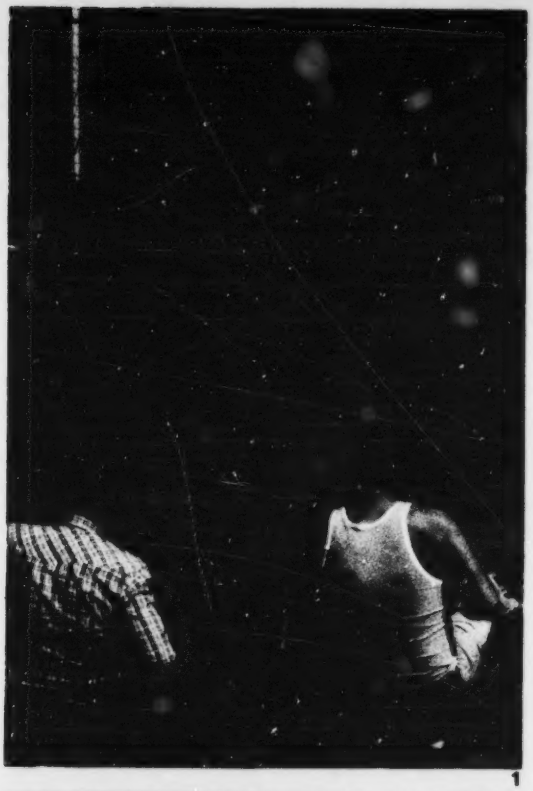
Species	Expected Production from 1983 Releases: Total Adult Production	Years of Return	Contribution to Fisheries	At Full Production: Total Adult Production	Contribution to Fisheries
Sechelt Community Development Project					
Chum	760	1987	335	720	317
Coho (Capilano)	1,300	1985	676	N/A	N/A
Coho (Sechelt)	436	1986	218	15,000	7,500
Chinook (Capilano)	377	1986	335	N/A	N/A
Chinook (Sechelt)	8	1987	6	1,755	1,404
Vancouver Bay Project					
Chum	200	1985-1987	175	30,000	26,250
Coho	486	1985-1986	272	N/A	N/A
Steelhead	147	1985-1988	74	N/A	N/A
Sliammon Hatchery					
Chum	27,820	1986-1987	12,240	25,000	10,000
Coho	1,515	1986	758	10,130	5,065

Tenderfoot Creek Hatchery
Not available at time of printing.

Capilano Hatchery
Not available at time of printing.

Seymour River Hatchery
Not available at time of printing.

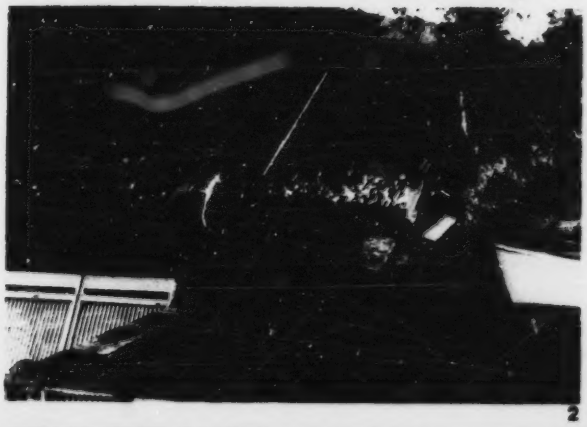
*Includes facilities constructed prior to SEP.
N/A means "not available."



1

Fraser River

1. *Departing chum fry were counted by a crew at Ed Leon spawning channel.*
2. *The new Eagle River facility built a fence to aid in capture of brood stock.*
3. *The hatchery at Spius Creek will begin operation in 1984 to test application of coastal techniques in the interior.*
4. *A crew from Inch Creek seined for brood stock on the Stave River.*



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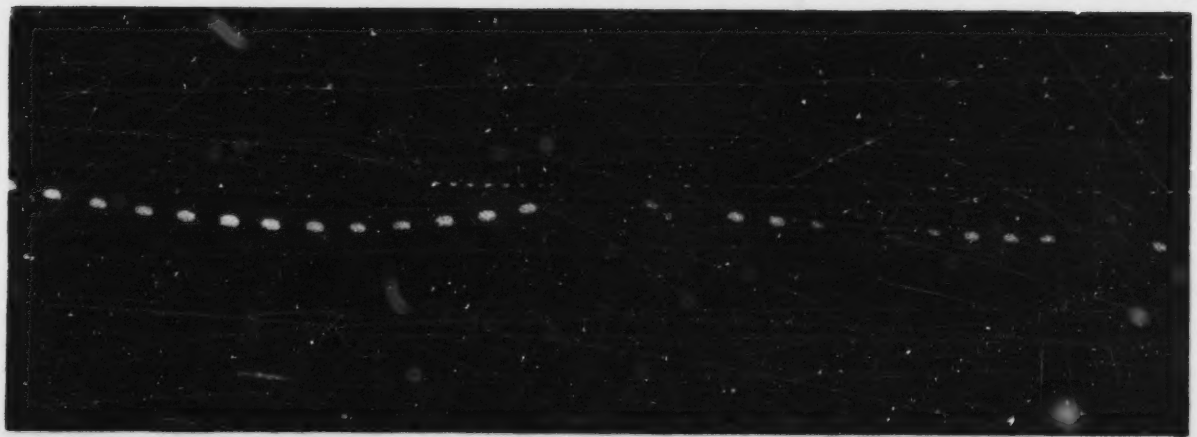

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Fraser River

Inch Creek Hatchery

Inch Creek hatchery, which is located 12 km east of Mission, underwent an extension of the water supply system and aeration tower to service the expanded facility in 1983. Two new pumps were installed, bringing the total water supply from 6,600 L/min to 20,000 L/min. Several stocks were enhanced this year with the following numbers of eggs being collected:

- 700,000 Blaney Creek chum
- 4.1 million Stave River chum
- 2.7 million Inch Creek chum
- 125,000 Inch Creek coho
- 72,000 Blaney Creek coho
- 25,000 Norrish Creek coho
- 70,000 Nicomen Slough coho
- 25,000 Siddle Creek coho.

Methods of chum brood stock capture were the same as in previous years. Almost all the coho brood stock was acquired by electroshocking. A fall release of 75,000 nose-tagged coho was done and their survivals will be compared to those of a spring 1984 release. All 1983 brood coho will be reared for an extended period.

Contact: Bill Foye, Stock Enhancement Officer, Enhancement Operations.

Alouette River Hatchery

The Alouette River hatchery is located on the South Alouette River, 10 km northeast of Haney. This project was initiated both to provide meaningful work for inmates of the Alouette River Correctional Center and to help build up the salmonid stocks of the Alouette River system. The Alouette River project is operated by the inmates and supervisory staff of the correctional center.

The facility's 1982-83 pilot operation, designed to test the water quality of the new well, was highly successful. On April 29, 93,756 chum fry, at an average size of 2.8 grams, were coded-wire tagged and released. The 35,627 coho from the 1982 brood are currently being reared to smolt size for release in June 1984. In addition, 28,000 steelhead are being raised to smolt size for a May release into the Alouette system.

Two new rearing channels were constructed by the inmates for the coho and steelhead smolts. A river intake was installed in the Alouette River and a new incubation building was constructed in anticipation of the 1983 fall egg-take.

Some 342,726 chum eggs and 5,500 coho eggs, taken in the fall of 1983, are presently incubating on the well water. The facility is also incubating 792,175 pink eggs from the Harrison River in the hope of reestablishing a pink salmon run in the Alouette. Forty thousand coho smolts are being reared as part of an ongoing recolonization program planned for the Brunette River, which drains into the Fraser at New Westminster.

Contact: Kim West, Biologist, Special Projects.

Fraser Valley Trout Hatchery

Fraser Valley trout hatchery at Abbotsford is operated by the provincial Ministry of the Environment and produces a variety of trout species, mainly rainbow, cutthroat and steelhead. More than twenty different stocks are handled during a typical year. About one-half of the hatchery's production is for SEP projects; the other half consists of nonanadromous trout stocks for lake management programs.

In 1983, twelve stocks of steelhead and three stocks of anadromous cut-

throat trout were incubated and reared at Fraser Valley trout hatchery. The majority of these fish were released as fry while the balance were retained for smolt production. Heated water can be used to accelerate growth during incubation and rearing to ensure suitable sizes are reached for both fry and smolts.

Audio-visual presentations, technical displays and small aquaria attracted about 30,000 visitors to the public display area at the hatchery in 1983. Both guided and self-guided tours of the display area are available.

Anadromous cutthroat and steelhead brood stocks required for fry and smolt stocking programs were collected in various ways. Electroshocking equipment has become the main method of collecting cutthroat from small Fraser River and Nicomekl River tributaries. Angling is the predominant method of capturing steelhead from large streams, although seining, trapping and electroshocking are all used in some instances. The Semiahmoo Fish and Game Club once again provided steelhead brood stock from their trap on the Little Campbell River. The Coast Steelheaders played a major role in the capture of steelhead from the Squamish River. B.C. Corrections Branch inmates and staff provided assistance with seining the South Alouette River for steelhead. Kanaka Creek steelhead were obtained from the fence constructed by B.C. Corrections Branch and operated as a public participation project. Green eggs from two northern steelhead stocks were flown from Smithers for incubation and rearing at the hatchery.

The number of anadromous fish produced in 1983 was up almost 40 percent over previous years, due mainly to the large number of northern steelhead reared. These northern fish were reared on elevated temperatures until late September at which time they were transported by truck back to the Smithers area. There they were scatter-released into the upper Zymoetz and Morice Rivers. Transport times exceeded 48 hours on this project with no ill effects to the fish.

Steelhead smolt production has remained fairly constant at the main hatchery over the past several years with about 60,000 being produced. This year, three groups of different sized steelhead smolts carrying different coded-wire tags were released at the same time into the Coquihalla River. It is hoped that returns from these releases will provide information about the ideal size of summer steelhead smolts at time of release.

Smolt production at the Alouette River Correctional Center was expanded with the construction of a large rearing pond. The number of smolts increased to 30,000 this year from 5,000 last year. Contract smolt production by Bakerview Trout Farm in Surrey came to an end this year after the release of smolts in May.

Anadromous cutthroat smolts produced at Inch Creek hatchery were once again used to stock Nicomen Slough, Stave River and Brunette River.

Contact: Don Peterson, Hatchery Supervisor, Fraser Valley Trout Hatchery, Abbotsford.

Chilliwack River Hatchery

The Chilliwack River hatchery is situated at the confluence of Slesse Creek and the Chilliwack River, 19 km from Vedder Crossing bridge and 32 km southeast of the city of Chilliwack. Phase I of hatchery construction was completed in April 1981.

Phase I capacity was designed for 5 million fed chum fry, 1.0 million coho smolts, 0.5 million chinook smolts and 150,000 steelhead smolts.

Phase II construction, which was originally planned for 1983-84, would have increased chum production to 10 million fed fry. Because SEP has entered a two-year transition period, this expansion has not occurred.

Considerable outplanting of smolts to donor streams occurred again in 1983; Dolly Varden Creek, Salwein Creek and Post Creek all received smolt out-

plants as part of an imprinting study. All smolts were marked with adipose clips and coded-wire tags. Timed releases of coho smolts were also made from the hatchery to determine optimum release strategy for coho smolts from this site.

In May 1983, 114,000 Chilliwack hatchery steelhead smolts averaging 70 grams were released at six sites throughout the Chilliwack River system. An additional 5,000 undersize steelhead smolts averaging 37 grams were released in four urban lakes. Two releases totalling 100,000 fed fry were also made into Chilliwack River tributary streams; these fish averaged between 1.8 and 4.2 grams.

Chinook smolts and fed chum fry were released from the hatchery; the numbers are listed in the juvenile releases table.

In the fall of 1983, 1.5 million eyed Harrison River chinook eggs were transferred from Chehalis River hatchery to Chilliwack. No eggs from indigenous red-fleshed chinook were obtained this year.

The chum run in the Chilliwack was extremely weak this year and only 1.8 million of the 3.0 million egg target was obtained.

A total of 2.7 million coho eggs were taken from Chilliwack tributary stocks to bring the facility up to full capacity and to produce an additional 0.7 million smolts for Expo 86.

To accommodate these extra eggs for Expo 86, the incubation capacity was brought up to design limits. Additional rearing units will be supplied in 1984 for final rearing.

The first adults from hatchery-reared stocks returned in 1983 with good survival of coho and jack chinooks.

Preliminary analysis of the first adult coho produced by the Chilliwack River hatchery indicates a substantial contribution to commercial troll and Strait of Georgia sport fishery, with smaller catches in the net fisheries.

A highly successful sport fishery in the Chilliwack River targeted on the chinook and coho returns resulting in the best coho fishing and the only chinook fishing seen in this river for many years.

Chilliwack River hatchery continues to contribute eggs and expertise to public involvement projects at the Centre Creek Corrections facility and Chilliwack Senior Secondary School.

Problems occurred this year with the large production well due to declining levels in the aquifer; it has been necessary to throttle the pump back 40 percent to prevent drawing down the aquifer and causing a shutdown. This puts severe restraints on growth rates for steelhead, chum, and chinook. A new well is planned for 1984.

Contact: Don Buxton, Stock Enhancement Officer, Enhancement Operations.

Chehalis Band Project

This project, located on the Harrison River in the upper Fraser Valley, provides training for local residents in fish culture techniques and project management to optimize their chances for employment at the Chehalis River hatchery. It also focuses on the assessment of groundwater-fed spawning channels for chum production.

In 1983, the project reared and released 1982 brood Harrison chinook at the Chehalis Band's Smokehouse hatchery facilities. Chum fry from five incubation pits and one groundwater-fed spawning channel were enumerated, as were adult chum in the improved areas and spawning channels.

Three incubation pits were given major modifications to improve flow, and the chum spawning habitat was improved by extensive removal of beaver dam obstructions.

The community based Smokehouse Slough facility will operate for a brief period to eye chum eggs destined to be planted in the five pits. Experience gained by the crew members will make them excellent candidates for employment at the Chehalis River hatchery when openings occur.

The project provides 4.2 person-years of employment for a crew ranging from two to eight members.

The five incubation pits and the two groundwater-fed spawning channels will continue in operation in 1984, as will the maintenance, habitat improvement and monitoring activities.

Contact: Chris de Hrussoczy-Wirth, Project Coordinator, Special Projects Division.

Chehalis River Hatchery

The Chehalis River hatchery is located approximately 95 km east of Vancouver, near Harrison Mills. The hatchery is adjacent to the lower Chehalis River, 3 km upstream from its confluence with the Harrison River. The facility has capacity for 14 million chum eggs, 3 million chinook eggs, 750,000 coho eggs, 240,000 steelhead eggs, and 42,000 cutthroat eggs. A mixture of conventional and Japanese-style hatchery methods are used at the site. The Chehalis River hatchery has been in operation since October 1982.

The first releases of juvenile chinook and chum salmon from Chehalis River hatchery were made in spring 1983. Releases were 31 percent and 83 percent of full production targets, respectively. Several different stocks of coho successfully underwent their first year of rearing at Chehalis in 1983, with facilities filled to 95 percent of full capacity. Initial incubation and rearing of steelhead and cutthroat trout at Chehalis also occurred in 1983. Steelhead production from these juveniles should approach 65 percent of full production targets. Cutthroat production will be about 29 percent of full capacity.

Fall brood stock collection in 1983 was highly successful. Egg targets for chinook, coho, and chum salmon were either met or exceeded. The majority of the brood stock capture was carried out by the Chehalis Indian Band under contract. Fish were seined, gillnetted, or trapped on the Harrison and Chehalis Rivers as well as a number of smaller tributaries. After capture, most of the fish were transported by Chehalis River hatchery staff to the hatchery for holding and egg-takes. In total, 15 million chum eggs, 4.5 million chinook eggs, and 800,000 coho eggs were collected. Approximately 1.5 million of the chinook eggs collected at Chehalis were transferred at the eyed stage to the Chilliwack River hatchery in a continuing attempt to build a strong chinook run to the Chilliwack River.

One highlight of 1983 was the large number of tourists visiting the facility. Seventy-five to 100 visitors a day were not uncommon on weekends. On occasion the number of visitors in a day was over 300. A guest book at the hatchery recorded visitors from across Canada, as far south as Texas in the United States, as well as from various points in Europe, the Far East, East Africa and New Zealand.

The Chehalis River hatchery is designed to produce increased catches for the commercial, freshwater, saltwater sport and Indian food fisheries, of approximately 150,000 chum, 58,000 chinook, 48,000 coho, 4,000 steelhead and 3,000 cutthroat trout. The hatchery will approach full production in 1984.

Contact: Larry Kahl, Stock Enhancement Officer, Enhancement Operations.

Jones Creek Spawning Channel

The Jones Creek spawning channel is located approximately 16 km southwest of Hope. The channel was constructed in 1954 as a solution to salmon problems created by a high-head diversion hydroelectric development at Jones (Wahleach) Lake. The Wahleach hydro-

electric project of the B.C. Electric Company (now B.C. Hydro and Power Authority) resulted in the diversion of a large proportion of the natural water flow from Jones Lake into penstocks at the Wahleach power generating station located 13 km downstream from the mouth of Jones Creek, adjacent to the Fraser River. In order to compensate for the impact of reduced and irregular flows, the B.C. Electric Company constructed the channel adjacent to lower Jones Creek according to Department of Fisheries' specifications. The company agreed to maintain the channel and provide a sufficient flow to ensure its successful operation by the Department of Fisheries and Oceans. An average of 2,000 pink salmon utilize the channel in the odd years. A few chum salmon and the odd coho also use the channel. The optimum number of spawners for the channel appears to be about 2,050.

B.C. Hydro completed spawning channel maintenance and upgrading prior to the 1983 fall spawner returns. However, the 1983 returns of pink salmon to the Jones Creek spawning channel were very low. The poor return was probably due to a combination of heavy fishing pressure and extremely low water levels in September 1983, which may have caused fish to spawn elsewhere. The 1983 channel escapement was only 332 fish compared to a 1981 brood escapement of 2,094, down 84 percent. Johnson Slough, draining into the Fraser River across from Jones Creek, also had a greatly reduced pink salmon escapement, reportedly 71 percent lower than in 1981.

The 1983 chum salmon escapement to the Jones Creek channel was down slightly, being approximately 145 fish. Coho returns to the channel were less than 10 fish.

A pink salmon egg transplant to the Jones Creek spawning channel, using eggs from a nearby stock and milt from Jones Creek males for fertilization, is being considered should early returns in 1985 indicate another poor escapement. An effort to enhance coho in Jones Creek is also planned for the future. This will probably be accomplished by an offsite rearing program at Chehalis River hatchery with smolts released back into Jones Creek. Due to the low numbers of coho remaining in Jones Creek, donor stock will have to be obtained from Lorenzetta Creek, a tributary of Jones Creek.

Contact: Larry Kahl, Stock Enhancement Officer, Enhancement Operations.

Birkenhead River Hatchery

Birkenhead River hatchery is located approximately 2 km north of Mount Currie on the east bank of the Birkenhead River. The hatchery is primarily a chinook enhancement facility, with a rearing capacity of 250,000 fry. It is now in its seventh year of production, each year's production surpassing the last.

In spring 1983, 141,500 chinook fry (1982 brood) were reared, then released into the Birkenhead River. The fry were separated into three groups, coded-wire tagged and released at different times from April 6 through to May 31 for time-of-release evaluation.

The chinook brood stock capture was completed entirely by angling. The 90 adults captured (1983 brood) were held in the settling pond up to three months until ripe. They were then spawned and the eggs were placed in Heath tray incubators. The program surpassed the set quota of 200,000 eggs, the most eggs ever taken since operation of the hatchery began. Four of the chinook adults that were caught were marked individuals from tagged releases of previous years.

For the first time in the history of the hatchery, the fall program included coho brood stock capture. The objective was to determine the feasibility for coho enhancement in the future. A very successful combination of angling and gillnet capture methods supplied 16 adult coho for spawning. They were held in tubs until ripe, then spawned, providing the hatchery with 28,000 coho eggs.

This year, three rearing tubs, to complement the three existing tubs and the three initial rearing troughs, were added. This addition brought the rearing capacity of the hatchery to 250,000 fry.

In spring 1984, 60,000 chinook fry will be transported at swim-up to Inch Creek hatchery, near Mission, for rearing until tagging and release. The objective is to determine the feasibility of rearing chinook at Inch in the event excess eggs became available from the Birkenhead River. Just prior to tagging, the fry will be transported back to Birkenhead River hatchery to be coded-wire tagged then released into the Birkenhead River. An equal number of the Birkenhead reared chinook will be tagged with another code and released with the rest of the chinook fry.

Contact: Bill Foye, Stock Enhancement Officer, Enhancement Operations.

South Thompson Reconnaissance/Feasibility

Pilot facilities at Spius Creek and on the middle Shuswap River have been developed (see section on the Central Interior Special Employment Initiative). Potential chinook, coho and steelhead trout rearing capacities of selected streams, proposed as outplant locations in the South Thompson watershed, have been evaluated in a federally-funded report done by the Fish and Wildlife Branch. EVS Consultants Ltd. reported on studies of 1982 coho spawners in the Eagle, Salmon and Adams Rivers. Alpha Bioresources Consultants undertook additional rearing-capacity studies in 1983 for the middle Shuswap River and its main tributaries above and below Wilsey Dam. Water quality sampling and temperature monitoring of the Wilsey Dam reservoir continued through 1983.

Contact: Bruce Shepherd, New Projects Coordinator, Enhancement Operations.

Eagle River Hatchery

The Eagle River hatchery is located on the Eagle River approximately 70 km east of Salmon Arm. The Eagle River is part of the Thompson-Fraser system, connected through the Shuswap Lakes.

This hatchery was completed in the fall of 1982 and was planned so that it can either be expanded to deal with all South Thompson stocks, or modified to shift its emphasis to other species, or stock mixes.

A permanent fence was built on the Eagle River to facilitate capture of adults. Chinook escapement to the Eagle River was extremely low; only 127,000 chinook eggs were taken. In addition, 425,000 coho eggs from the Eagle River and 200,000 coho eggs from the Salmon River were also taken.

Resulting fry will be returned to their native river in the spring of 1984. An extensive coded-wire tagging program will be undertaken to evaluate imprinting and to assess fry stocking.

Contact: Dick Harvey, Stock Enhancement Officer, Enhancement Operations.

Central Interior Tribal Councils Fisheries Program

The Central Interior Tribal Councils, headquartered in Kamloops, represents native communities whose traditional area extended throughout most of the southern third of the province. The western boundary is marked by Pemberton and part of the Chilko River. The northern boundary is in the vicinity of Williams Lake, and the B.C./Alberta border forms the eastern boundary. The U.S./Canada international border forms the southern boundary, west to the height of land, east of the Fraser River up to Boston Bar. Most fisheries activities are concentrated on the Fraser from Boston Bar to north of Lillooet, the Lillooet and Bridge River systems and the entire Thompson drainage area.

The project is intended to identify salmonid enhancement opportunities and to develop specific development proposals in conjunction with adjacent native communities.

Numerous target areas were identified as potential enhancement sites. These included the Bridge/Yalakom, Nicola, Deadman, Seton/Portage, Barriere and Adams/Little Shuswap River systems. Extensive field studies were carried out to supplement existing information or to provide new information regarding adult escapements, run timings, population statistics, emergence and emigration timings and habitat classifications. These studies are directed primarily at chinook and coho stocks. The project, developed with the North Thompson Band, is the first of the specific proposals to have been completed.

The Central Interior Tribal Councils was the contracting agency. The contract provides approximately three person-years of employment. The project staff consists of a full-time biologist and technician, three seasonal technicians and a seasonal office assistant.

Studies will continue in 1984 to support the development of site-specific, community-based enhancement project proposals.

Fisheries managers are provided with invaluable information resulting from field studies, as the data to support enhancement proposals are also fundamental to resource management decisions. Native communities identified in the specific proposals will have the opportunity to build stable economic bases around enhancement developments.

Contact: Chris de Hrussoczy-Wirth, Project Coordinator, Special Projects Division.

Central Interior Special Employment Initiative

Four pilot projects have been funded in the Fraser-Thompson area of the central interior of British Columbia as part of a Government of Canada Special Employment Initiative.

Work continued on these projects which will be expanded in 1984 and 1985.

Spius Creek

Spius Creek discharges into the Nicola River approximately 18 km downstream from Merritt. The Spius Creek pilot hatchery is located on Crown land on the right bank of Spius Creek near its confluence with the Nicola River. The pilot's main purposes are to find out if coastal hatchery techniques can be applied to the interior and to refine outplanting techniques to maximize survival and homing.

Work undertaken at this facility in 1983 included:

- topographical and hydrological surveys, including a flood analysis study
- construction of an access road
- construction of a three-phase power supply line to the site
- development of an excellent groundwater supply through an exploration, drilling and testing program
- construction of a 314.5 m^2 hatchery building containing a workshop, mechanical room, incubation room, offices, laboratory, washrooms and storage area
- construction of a crew residence
- fabrication and installation of eight aluminum Capilano-type intermediate rearing troughs and three aluminum raceways
- construction of an aeration tower for the groundwater supply
- construction of an effluent settling basin.

The following additional work will be undertaken at this facility commencing in 1984 with the main portion of the construction slated for 1985:

- a gravity surface water supply from Spius Creek including an intake and settling basin
- additional intermediate and final rearing facilities
- a walk-in freezer for fish food
- a sprinkler irrigation system for

studying the feasibility of disposal of effluent on land.

The pilot will begin operation in 1984 at the facility's proposed production capacity of 220,000 chinook and 105,000 coho eggs, resulting in a total adult production of 3,600 chinook and 2,300 coho. Brood stock will be taken from the Coldwater and Spius systems, and the resulting juveniles will be outplanted back into their home streams.

The pilot will expand operation in 1986 to a proposed production capacity of 17,000 adult chinook salmon, 9,000 coho salmon and 2,000 steelhead. The expansion will allow Nicola, Deadman, Maka and Guichon chinook and coho stocks to be used for studies of release techniques.

Contact: George Nielsen, Senior Project Engineer, Engineering; Bruce Shepherd, New Projects Coordinator, Enhancement Operations.

Shuswap River

The Shuswap River pilot is located on the middle Shuswap River which flows between Sugar Lake and Mabel Lake. The pilot is situated within W.J. Tolley Park, which is administered by the North Okanagan Regional District and is located immediately downstream from Shuswap Falls, approximately 12 km from Lumby.

An access road and a single-phase power supply were constructed. Additional topographical surveys were undertaken in the general area, and a groundwater exploration, drilling and testing program was initiated in order to develop a suitable groundwater supply which was required for the proposed facility.

A pilot hatchery, consisting of a pumped well-water supply, aeration tower, prefab metal building enclosing an office, incubation and rearing facilities, was constructed.

Negotiations began with adjacent landowners with a view to acquiring additional property required for the construction of an expanded pilot to be completed in 1985. In addition, the groundwater drilling program will be extended to develop sufficient groundwater supplies required for the operation of the expanded pilot.

Expansion work proposed for 1984 and 1985 includes construction of a main hatchery building, residence, freezer, rearing facilities, a gravity surface water supply from Shuswap Falls dam and installation of a three-phase power supply to the site.

The pilot will begin operation in 1984 at a production capacity of 110,000 chinook eggs, resulting in a total adult production of 1,800 adults. It will focus on evaluating the feasibility of planting Shuswap-origin chinook juveniles into unutilized rearing areas above the Shuswap Falls dam.

The expanded pilot will begin operations in 1986 with a proposed production capacity of 1.9 million eggs or 1.2 million released smolts resulting in a total adult production of 16,000 chinook salmon and 6,000 coho salmon. The expanded pilot will allow middle and lower Shuswap, Wap and Bessette chinook and coho stocks to be used to study release techniques downstream from the dam.

Contact: George Nielsen, Senior Project Engineer, Engineering; Bruce Shepherd, New Projects Coordinator, Enhancement Operations.

Stuart River Pilot Hatchery

The Stuart River pilot project is located 3 km north of the Stuart River, within the village limits of Fort St. James. It was initially constructed and operated in 1980/81 to test the feasibility of rearing chinook fry in an artesian water supply containing marginally high levels of iron. The fish, which were over 1 gram in size, did not seem to be affected.

This pilot was again operated in 1982/83 to assess the effects of iron on chinook in the egg and early fry stages. The results suggest that the water should be filtered for the egg and alevin stages. At these stages, the experimental group on the unfiltered water supply suffered developmental retardation and aberrations, as well as high mortality, while the fish in filtered water had a good survival rate. Beyond the late alevin stage, unfiltered water was used with no ill effects. Overall survival (77%) was excellent, considering the high early mortality of the experimental groups. In total 53,687 smolts (3.3 - 4.6 g) were released in two separate tagged groups April 6 and 26 into the Stuart River. It was concluded that, with only minor treatment, this water supply could be used for a salmonid production facility.

Extensive modifications were undertaken at the facility in 1983, transforming it into a small production facility. Modifications included the construction of a larger aeration tower needed for the artesian groundwater supply and the installation of a head tank and a fabric filter system for removing iron floc from the water supply.

The modifications also included the installation of additional incubation and rearing facilities, resulting in a production capacity of 166,000 chinook eggs or 120,000 released smolts. A production of this size should result in a total adult chinook salmon return of 2,700.

In fall 1983, the pilot was turned over to local residents under the auspices of the Community Economic Development Program of SEP Special Projects Division.

Contact: George Nielsen, Senior Project Engineer, Engineering; Bruce Shepherd, New Projects Coordinator, Enhancement Operations.

Clearwater River

The Clearwater River pilot is located within the Village of Clearwater, on the left bank of the Clearwater River approximately 2 km upstream from the confluence of the Clearwater River and the North Thompson River.

Work undertaken at the facility in 1983 included:

- purchase of property for the facility
- construction of an access road
- development of a groundwater supply including installation of two submersible pumps and the construction of two pumphouses
- construction of a three-phase power supply line to the site
- construction of a 285.6 m^2 hatchery building containing a workshop, mechanical room, incubation room, washroom and storage area
- fabrication and installation of eleven aluminum Capilano intermediate rearing troughs and four modular aluminum raceways
- construction of an aeration tower.

This facility will be expanded in 1984, with the major portion to be constructed in 1985. This work will include:

- expansion of the existing hatchery building which will include offices, lunch room, washrooms and freezer
- construction of roofing over intermediate rearing troughs
- construction of an additional aeration tower
- development of additional groundwater supplies including pumps and pumphouses
- construction of concrete rearing channels.

The pilot will be operated in 1984 under contract. The proposed production capacity of the facility is 440,000 chinook and 210,000 coho eggs, with a projected total adult production of 7,200 chinook and 3,400 coho. Chinook brood stock will be obtained from the Clearwater and Raft Rivers and Finn and Lemieux Creeks; coho brood stock

from Dunn and Lion Creeks. All resulting fry will be outplanted into their home streams.

The expanded pilot will begin operation in 1986 with a proposed production capacity of 1.8 million chinook and 1.0 million coho eggs, resulting in a total adult production of 19,000 chinook and 18,000 coho salmon.

Contact: Wayne Peterson, Senior Project Engineer, Engineering; Bruce Shepherd, New Projects Coordinator, Enhancement Operations.

Louis Creek Coho Hatchery

The Fish In a Natural Setting (FINS) club took 30,000 coho eggs from Louis Creek in the fall of 1983. The resulting fry will be released in May 1984.

Contact: Dennis Demontier, Community Advisor, Kamloops, Special Projects.

North Thompson Band Community Project

The North Thompson Band lives at Chu Chua, in the North Thompson basin, approximately 90 km north of Kamloops. They operate a project at Dunn Lake, approximately 25 km north of Chu Chua.

As with all Community Economic Development Projects, the objectives are fish production and local employment, but the biological rationale for the project is experimental rather than production-oriented. The project has grown out of a keen community interest which was instrumental in initiating a project under the 1982 federal job creation program, and subsequently was supported by Employment and Immigration and by SEP's Community Economic Development Unit. The objectives of this small incubation box project are:

- to determine rate of straying versus the distance outplanted downstream from the hatchery
- to determine if size at release affects the rate of straying. For instance, fingerlings released back to the native stream at a large size may not imprint successfully because of a tendency to emigrate immediately
- to determine if retention of large fingerlings in the native stream improves homing
- to compare the survival rates of fish at different sizes at release.

Work in 1983 included:

- lake-pen rearing (at Dunn Lake) and coded-wire tagging of 1982 brood coho incubated on the domestic water supply at Chu Chua village
- extensive participation in adult, juvenile and habitat classification field studies
- development of a gravity-fed surface water supply and multi-compartment upwelling incubator at the Dunn Lake outlet
- development of a proposal which secured enough funding to develop a lake-pen rearing facility complete with temperature-control capacity
- brood stock collection and egg-takes for two target streams
- a groundwater reconnaissance/monitoring program.

North Thompson Band Council was the contractor. Three person-years of employment were provided, with some additional employment program funding supplying additional staff for those activities requiring it, e.g. coded-wire tagging.

Work to be done in 1984 will include:

- construction of the proposed lake pen rearing facility
- modifications to the water supply intake and to the incubator.

Results of the study objectives will complement the information gathered by the operation of the Clearwater pilot. With questions regarding the optimum strategy for upriver coho and chinook enhancement answered, both facilities will be able to participate in the badly needed restoration of North Thompson stocks on a production basis.

Contact: Chris de Hrussoczy-Wirth, Project Coordinator, Special Projects.

North Thompson Reconnaissance/Feasibility

Reports on the baseline juvenile studies undertaken in 1982 on the Clearwater, mainstem North Thompson, Finn, Raft, Joseph, Dunn, Lemieux and Barriere systems were completed by Envirocon Consultants Ltd. Coho spawner sampling and surveys from 1982 were reported on as part of a Field Services NEED (job-creation) project in the area.

As part of the Central Interior Special Funding Initiative (detailed elsewhere), a pilot facility is being developed in the town of Clearwater. Monitoring of this and other potential facility sites continued through 1983.

Finn Creek

Finn Creek discharges into the North Thompson River 16 km north of Avola. The artesian-flow system developed at this site in 1982 was monitored through 1983 as to flow, water quality and temperature. The site has potential as a small incubation/rearing facility, perhaps implemented as a public involvement project.

Mahood River

Mahood River flows into the Clearwater River 35 km north of Clearwater. A well, developed in 1981, was sampled with regard to water quality and monitored for temperature through 1983. A summary memo report on the sampling should be available in 1984.

Clearwater River

In addition to two new wells drilled for the pilot facility, two existing wells belonging to local residents in the town of Clearwater were also sampled and their temperatures monitored through 1983. A summary memo report on these samplings should be available in 1984.

Contact: Bruce Shepherd, New Projects Coordinator, Enhancement Operations.

Loon Creek Hatchery

Loon Creek hatchery is located on Loon Creek, a tributary of the Bonaparte River, 23 km north of Cache Creek. It has been operated by the Fish and Wildlife Branch (FWB) since the 1950s and was expanded in 1979-1980 in a joint SEP/FWB venture to accommodate chinook salmon and to increase steelhead trout production.

Adult chinook salmon cannot negotiate the falls below Cache Creek to utilize the upper reaches of the Bonaparte River for spawning or rearing. Consequently, adult donor stock is captured by angling below the falls and is held until maturity in gravel ponds at the facility. Eggs are taken from mid-August to mid-September. The resulting fry are then reared in the hatchery building. The facility consists of an incubation room, eight rearing troughs for chinook salmon and three circular ponds for steelhead trout.

Total rearing capacity of the hatchery for chinook is about 175,000 fry, but brood stock availability prevents reaching this goal. Brood stock from the Deadman River is also incubated and reared at the hatchery and returned to the Deadman River.

A total of 21 females and 12 males was captured from the Bonaparte River and 15 females and 9 males from the Deadman River, with a total fry release of 34,360 and 32,630 respectively. Most of the fry were coded-wire tagged prior to release. A total of 81,500 steelhead fry from the Nicola River was incubated and returned as unfed fry. About 68,000 unfed fry were released in the Bonaparte River, and about 45,000 fry will be reared to smolt size for release in mid-1984.

Five coded-wire tagged chinook adults from the 1980 Bonaparte River brood were captured during brood stock collection, which is quite encouraging. The Loon Creek hatchery will continue its present chinook and steelhead program.

Contact: Dennis Graf, Hatchery Supervisor, Loon Creek Hatchery, Fish and Wildlife Branch, Cache Creek: Gordon Bérézay, Biologist, Enhancement Operations.

Quesnel River Hatchery

This major chinook hatchery is located 85 km northeast of 150 Mile House and 2 km west of Likely. Construction of this hatchery was completed in the summer of 1982. The design capacity for this facility is 3.9 million eggs. Its goal is to enhance chinook stocks in the upper Fraser River watershed. It is anticipated that this hatchery will be at full production for the 1984 brood year.

This facility utilizes Heath trays for incubation, aluminum troughs for initial rearing and large cement channels for final rearing. The water supply is well water supplied by two production wells and one test well. No river water is utilized.

From March 18 to May 13, 1983, all of the 1982 brood chinook juveniles were released into the following rivers:

- Blackwater River - 39,477
- Bowron River - 334,983
- Nazko River - 387
- Quesnel River - 509,918
- Slim Creek - 498,181.

These chinook juveniles were released into their native streams from which the eggs had been collected.

An imprinting/time-of-release experiment occurred with the Bowron stock at the time of release. The imprinting experiment was designed to determine whether it is necessary to hold the fry in their native streams for a period of time before release in order to ensure that the adults return to it. The experimental design called for one group of fry to be held in net pens at the Bowron River release site for one week. Another group of fry, equal in number, would be released on the same date as the net-penned fry. Each group of fry would be tagged with separate coded-wire tags.

The time-of-release portion of the Bowron experiment was incorporated into the imprinting experiment. Two separate release dates occurred with the above imprinting experiment carried out for both dates.

The Quesnel stock was used in three experiments. As described in the 1982 annual report, a genetic experiment was initiated with the native red and white fleshed chinooks. At fertilization the following crosses were made: red female with red male; red female with white male; white female with white male; white female with red male. Each of these crosses was kept separate throughout incubation and rearing. Each of the crosses was tagged with coded-wire tags in order to provide comparative information on adult returns and flesh coloration.

The second experiment was a time-of-release experiment that was designed to acquire information on when chinook juveniles should be released from the hatchery to obtain the optimum adult survival rate. Equal groups of chinook juveniles were released every two weeks from March 18 to May 13. The juveniles from each of the releases were marked with coded-wire tags to determine the survival rates for each group.

The final experiment was on imprinting at the brood stock collection site using net pens for holding the fry one week before release. These fish were also marked with coded-wire tags. The object of this experiment was to determine if it was necessary to hold the fry in the river for a length of time before release to ensure that they returned to the point of release instead of the hatchery water outflow.

In 1983, brood stock collection was limited to less than 50 percent capacity for the second year in a row due to budget constraints. The following number of chinook eggs were collected from these donor streams:

- Quesnel - 491,689
- Cariboo River - 98,848
- Bowron River - 543,305
- Indianpoint Creek - 93,531
- Blackwater River - 277,431
- Nazko River - 175,500
- Horsefly River - 24,197.

Coho spawning was observed in the Quesnel River system for the first time. A total of 25,065 coho eggs were collected from McKinley Creek.

Contact: Robin Dickson, Stock Enhancement Officer, Enhancement Operations.

Upper Fraser Reconnaissance

Chilcotin River Reconnaissance

A survey was undertaken to obtain additional information on potential enhancement sites located on the Chilanko, Taseko and Chilko Rivers.

Anderson River Reconnaissance

A survey was undertaken on the Anderson River system near Boston Bar. It located an impassable obstruction in a steep canyon area approximately 4 km upstream.

Considering the low benefit to the fishery resource, the high cost of removing the obstruction could not be justified at the time.

Aerial Photography and Ground Control Surveys

Aerial photography and ground control surveys were completed on the following river systems in order to proceed with topographical mapping of potential enhancement sites:

- Chilko River system (potential chinook enhancement facility), including the Chilko River at the outlet of Chilko Lake and Elkin Creek at the outlet of Elkin Lake
- Stuart River system (potential sockeye spawning channels), including Driftwood River, Kazchek Creek, and Tachie River.

General Topographical Surveys

Topographical and hydrological surveys were undertaken at the Bonaparte River obstruction in order to provide information required in the design of fish passage facilities.

Topographical and hydrological surveys were also carried out at three side channels on the Thompson River in order to provide information required in the design of proposed facilities to enhance salmon production at these locations.

Contact: George Nielsen, Senior Project Engineer, Engineering.

Penny Pilot Hatchery

This pilot chinook hatchery is located 105 km east of Prince George on the north side of the Fraser River. This satellite facility has the capacity to incubate and rear 200,000 chinook fry to release size. Originally built in 1980, the facility was upgraded to its present size in 1981. The goals of this experimental facility are to determine the success rate of:

- ponding chinook fry into water with initial rearing temperatures of 2.0°C-4.0°C
- adult survival rates from a late release of 1.5 gram fry in the upper Fraser River
- imprinting the fry to their native stream.

This facility utilizes Heath trays and upwelling gravel boxes for incubation and aluminum troughs for rearing. The water supply is surface water provided by a gravity feed pipeline from Rankin Creek.

From May 17 to July 4, 1983, 178,126 chinook fry were released into James Creek on the McGregor River system. All the fry were transported by helicopter from the hatchery to the release site.

After the final release of the chinook fry in July, the pilot hatchery was closed down due to budget constraints. This pilot hatchery, during its three years of operation, has pro-

vided and will continue to provide some important fish culture answers. Successes include:

- initial rearing of chinook fry in water temperatures ranging from 2°C-4°C
- no apparent disease problems associated with the water supply.

Negatives of the operation were poor accessibility and high ammonia level in the water supply. Two important unknowns will be answered when the coded-wire tagging information from all three years of fry releases becomes available when the adults return between 1985 and 1988. These unknowns are: fry-to-adult survival rates and whether the adults imprint to their release site or return to the hatchery.

Contact: Robin Dickson, Stock Enhancement Officer, Enhancement Operations.

Stuart River/Necoslie Band Project

In summer 1983, the Stuart pilot project, previously operated by Enhancement Operations, was handed over to the Community Economic Development Program to develop a community-based project. The pilot hatchery facility, originally developed to test marginal iron concentration in a hatchery water supply, is located in Fort St. James village near the outlet of Stuart Lake (approximately 100 km north of Vanderhoof).

As insufficient time was available to organize a community contractor prior to egg-take, and, as the year would be primarily a training period for that contractor, only 55,000 Stuart River chinook eggs were collected.

On October 16, negotiations were concluded with the Necoslie Band to train three individuals in biotechnical and management skills involved in the operation of the hatchery. These individuals have been participating in an intensive training program.

The 1983 brood chinook will be reared to approximately five grams, for release in late April 1984. The egg-take target for 1984 is 170,000 Stuart River chinook eggs; this will operate the facility at capacity.

Contact: Colin Masson, Project Coordinator, Special Projects Division.

Provincial Status Report

Chilliwack River Steelhead Production and Evaluations

During 1983, 10,000 steelhead smolts (68 g) were reared at the Salwein Creek net pens and released into the Chilliwack River. In addition, 58,000 fingerlings (6 g) of Chilliwack brood stock were reared at Abbotsford research hatchery, the research wing of the Fraser Valley trout hatchery. These fish were transported to the federal Chilliwack River hatchery at the end of summer for smolt culture in rearing channels. Twelve thousand grade-down fingerlings were also stocked into barren sections of Slesse and Foley Creeks.

Evaluations of coded-wire nose tag recoveries in the 1983 Chilliwack River steelhead fishery were continued. Relative returns were compared for steelhead smolts raised in circular hatchery tubs versus those raised in Salwein Creek net pens. The latter group was more evident in steelheaders' catches.

Sea-run Cutthroat Production and Evaluation

During 1983, 43,000 cutthroat smolts (60 g) were reared at Abbotsford research hatchery and released into the Hope-Camp slough system. Further production of this stock will be carried out by the Fraser Valley trout hatchery because research activities have been redirected to evaluations of fingerling and smolt stocking of cutthroat at Little Campbell River.

Cooperative fence operations at Little Campbell River with the Semiahmoo Fish and Wildlife Club and SEP's public involvement program have

provided the opportunity to examine out-migration success of stocked cutthroat and steelhead smolts, and the survival to smolt stage of 5,000 fingerlings planted in underutilized habitat upstream of the fence. Results have demonstrated serious residualism in hatchery cutthroat smolts (40 percent migration).

Contact: Bob Land,
Research Hatchery Supervisor,
Abbotsford Research Hatchery.

Lower Fraser River Steelhead and Cutthroat

Alouette River is in its sixth year of a hatchery smolt stocking program. Hatchery operations are cooperatively done between Fraser Valley trout hatchery and the Alouette River Correctional Center. During the 1982/83 steelhead run, wild and particularly hatchery returns to the river were strong. Compared to 81/82, angler effort was up by 200 percent and catch was up by 450 percent. The hatchery portion of the catch was 68 percent. The South Alouette was the region's third most heavily fished stream and ranked second for total catch.

Vedder River winter steelhead angling now ranks first in the region for catch and angler effort (provincially, it is the second most heavily fished river for steelhead behind the Thompson, and it ranks third for total steelhead catch behind the Gold and Dean Rivers). Compared to the previous season, angler effort was up by 30 percent and catch increased by 18 percent. Improved angling on this river is directly related to a greater abundance of steelhead. This increase in numbers of fish is due to restrictive harvest regulation for wild steelhead and a prominent stocking program undertaken with Chilliwack River hatchery. Using brood stock captured in 1983, this hatchery will reach its full steelhead smolt production by spring 1984.

Provincial staff collected the first winter steelhead and searun cutthroat brood stock for the Chehalis River hatchery. Offspring from these fish will be reared to smolt stage and stocked in Chehalis River, Weaver Creek, Big Silver Creek, Cogburn Creek and Harrison River in spring 1984.

Summer-run steelhead programs continued on the Coquihalla River and Silverhope Creek. Special angling fisheries occurred on the Coquihalla for the seventh year, and on the Silverhope for the first time in many years. First adult returns from summer steelhead fry stocking into upper Silverhope were expected to show up in this fishery and in the subsequent capture of brood stock. Results were very poor and hope now rests on the 1984 run showing a large proportion of fry program returnees.

Stocking of cutthroat smolts, raised at the Fraser Valley trout hatchery and Inch Creek hatchery, continued in 1983. Hope Camp Slough near Chilliwack has been stocked since 1978, while Stave River, Nicomen Slough, and Brunette River have had hatchery input since 1981. Results of these stockings are very encouraging. Hatchery fish are showing up strongly in angler catches in a variety of Fraser River locations. Angler effort, directed at cutthroat, is increasing rapidly.

Contact: Peter Caverhill, Fisheries Biologist, Fish and Wildlife Branch, Surrey.

Chilliwack River - Lower Fraser River Stock Modelling

In summer 1983, an investigation was initiated to provide the scientific basis for managing the steelhead harvest in the Chilliwack-Vedder River. The goal over several years was to define maximum habitat capability based on current models and total useable area. First efforts were to define roughly the fry capacity of the study area (Sweltzer River upstream to Chilliwack Lake outlet; a distance of 47 km and an area of 182 hectares). Included in the field study was the location of suitable release sites and determination of optimal spawner escapement and harvest. Gradient profiles were gener-

ated for the mainstem and all tributaries. No pre-release assessment of wild recruitment was completed due to time constraints.

Major findings include:

- for each index station plus one whole river metering, transect depth and velocity suggest excessive depths/velocity for fry and smaller steelhead parr at points close to shore
- using mainstem length and mean number of fry per lineal metre, the mainstem capacity appears limited to 600,000 mid-September fry. This is equivalent to 0.13 fry per 100 m stream or 33 fry/100 m^2 total stream area
- the population of fry captured during census was comprised of 31 percent wild origin and 69 percent hatchery origin by length-frequency separation (Peterson method). Recent run size has been judged to be 3,000-4,000 adults and relates to smolts yielded from both mainstem and tributary production areas.
- there is evidence of reduced growth for hatchery fry introduced at sites already operating near capacity. Better resolution of growth performance can be attained in 1984 with continuous temperature recordings over the growth period and length/weight sampling of background wild fry at release time. Results suggest better efforts are required to disperse fry at lower effective stocking density (<10,000 fry per release site).

Preliminary estimates of fry capacity (most limiting stage) suggest a maximum fry population under full seeding of 60 km mainstem would be near 780,000 fry. The historic smolt yield was probably near 117,000 while the adult run size was 14,000. If current biostandards are applicable, then near 4,700 adults should be manifest before any fishery occurs.

Annual plants of up to 85,000 hatchery smolts have been made within the study area. If significant proportions residualize in the stream, they may render the parr capacity lower due to density-dependent competition. The 1982-83 steelhead harvest analysis estimated 10,953 days fished by 1,548 anglers; some 66 wild steelhead were kept while 4,201 were released. Hatchery smolt releases have generated increasing hatchery adult catches with 322 heads recovered to date from the 1983-84 fishery. In 1982-83, the Chilliwack fishing effort (days fished) represented 7.3 percent of the provincial total and 30.9 percent of the Lower Mainland coast total.

In 1984, some 175,000 unfed fry will be released in late July-early August. The failure of hatchery fry released in 1983 to reach full growth potential will necessitate reducing the stocking density by greater dispersal. Creel census and harvest statistics will be reviewed for historic perspectives re: stock-recruitment.

Contact: Ron Ptolemy,
Fisheries Biologist,
Fish Habitat Improvement
Section, Fish and Wildlife
Branch, Victoria.

Coquihalla River Rearing Capacity Assessment

This project is located on the Coquihalla River near Hope.

This field work is experimental in nature and attempts to answer whether the exceptionally low adult returns (<200) to the Coquihalla mainstem above Othello are, in part, due to stream habitat limitations. Permanent closures or catch and release fisheries since 1965 have not led to improved run size as they have on streams on Vancouver Island. The present study is based on outplanting fed fry at habitat saturation levels by trial. Hatchery fry (1 g each) have been planted since 1981. The specific goals of the study include:

- to test whether the late August biomass of juvenile steelhead can be consistently maintained at a significantly greater level given no recruitment limitations
- to monitor the year-to-year variation in juvenile abundance and growth as a function of density-dependent and other factors

- to model the influence of habitat on fish abundance with the aid of Bovee (1978) probability-of-use curves
- to determine the present potential to produce more smolts and increase run size by examination of fish densities at index stations
- to review the relative performance of fry and smolt releases into the study area and suggest best means for restoration of the wild stock to achieve a run size (historic?) of 1,500 to 2,000 adults.

Considerable work has been completed over the past seven years. Population estimates and habitat unit descriptions have been completed for sixty-two index stations. Results have been reported in all previous annual (SEP) reports.

Earlier life-history and reconnaissance level sampling of various habitats have been reported by Ptolemy (1978). These were related to pre-impact assessment of the highway construction.

Snorkel census of parr in deeper, faster water (late August) and adult run size have been conducted and recorded.

This work has been summarized and analysed in a current report. It includes data necessary for data synthesis (e.g. flow, temperature, freeze-core substrate analysis, creel census).

Stream gradient analysis and air-photo interpretation of macro habitat, necessary for application of Slaney's 1981 parr model was conducted.

It has been found that the standing crop of juveniles can be significantly increased for all pre-smolt age groups to a level which is relatively uniform from year to year. Results of sampling in 1983 demonstrated the same abundance of fry under similar habitat conditions compared to 1981 and 1982. Fry, yearling and age (2+) parr densities were the highest observed compared to pre-stocking years.

Considerable year-to-year variation in juvenile abundance was observed prior to fry stocking. In most years, the year class strength of fry was directly proportional to the spawner escapement. Density-dependent pressures caused by excessive numbers of fry in 1983 and residualized smolts reduced the growth and biomass density of cohorts at some index stations.

Habitat quality expressed as a "use" index for mean depth, velocity and substrate was explained within any given year. Formulation of habitat rating curves permitted direct comparison to other streams with similar measurements and transformations.

Experience gained in 1983 suggests that fry stocking density in combination with wild fry recruitment should be limited by a threshold of 24 fry/$100m^2$ total stream area or about one fry/m^2 useable fry habitat in the Coquihalla. The present potential (wild) smolt yield is thought to be about 21,000 fish and appears naturally limited by stream structure, since only 25 percent of the 59 hectares is useable by fry at approximately 1.0 fry/m^2. Gross application of Slaney's (1981) parr-smolt model suggests a smolt yield near 36,000 smolts; there is a distinct possibility there is surplus, vacant parr habitat which might be made use of if appropriately stocked in the future.

While it is premature to judge the relative performance of fry versus smolt releases to date, neither technique will likely generate numbers of adult returns at historic levels. The maximum hatchery run size has been 200 adults in 1980 while the most optimistic projected adult return (at full fry saturation of the study area) should be 840 adults.

The annual August juvenile census should be continued at the present sampling density and with the same crew to:

- test the impact of the most extreme flood on record for the Coquihalla (in January 1984, a flow of 780 m^3/s) on fry-to-yearling survival

and movement/accumulation of sand imbedding cobble/boulder habitat.

- establish for the first time the relationship between habitat quality and parr abundance without the usual influence/interference of residualized smolts.
- monitor the impact of accelerated highway construction.

A trial release of 15,000 15 g (yearling equivalents) steelhead should be planted into the study area during October 1984. This is to further test Slaney's parr model and to determine whether additional wild smolts can be produced to meet the management target of 1,500-2,000 returning adults. This population should be surveyed in August 1985 for density, growth and survival estimation.

The benefit/cost ratio on hatchery smolt releases to date is low (<0.13:1), but the anticipated benefit/cost ratio for fry outplanting should be near 7.6:1 if no serious overstocking is seen. The benefit/cost ratio appears higher for other streams containing steelhead due to reduced age at smolting and/or lower catch/escapement ratios applied before a sport fishery is applied.

Surplus hatchery fry (above the requirements for the study area) are to be released in July 1984 below Othello at a density of 30 fry/100m^2 total stream area. The four-lane highway between Hope and Merritt is to be completed by 1986 and will, no doubt, create environmental problems. These additional perturbations will be monitored. First major adult returns (about 359 adults) following the 1981 fry plant are due in summer 1986.

Contact: Ron Ptolemy,
Fisheries Biologist,
Fish Habitat Improvement Section,
Fish and Wildlife Branch,
Victoria.

Nicola River Fisheries Assessment

This project is located on the Nicola River from Nicola Lake, near Merritt, to the Thompson River, near Spences Bridge. Investigations in 1983 included two major tributaries:Spius Creek and the Coldwater River.

This project was intended to last three consecutive years (1980-82) focusing on the role and relative importance of various components of the watershed for anadromous fish production. Specific objectives were:

- to identify the distribution and relative importance of salmonid spawning and rearing areas in the mainstem Nicola and major tributaries through counting of juvenile fish
- to relate existing production to habitat capabilities and constraints, while identifying enhancement opportunities for salmonids.

The third year of investigation (1982) uncovered a number of uncertainties and apparent inconsistencies in the data not evident from the first two years (1980 and 1981). In addition, some questions raised by 1980-81 investigations, particularly questions regarding chinook outmigration, could not be addressed in 1982 as a result of lower funding levels. Investigations were extended to a fourth consecutive year to help clarify apparent inconsistencies, and to gain a broader perspective in relation to natural variability.

A total of 31 fish sample sites were completed, of which 27 sites were index sites from previous years of investigation. Included in the field program was a first post-stocking assessment of steelhead fry liberations in Spius Creek. A number of questions regarding original interpretations arose from analysis of a third year of data. Final reporting on 1982 data was postponed until further information was collected in 1983. Analysis of the four consecutive years of data will be completed in 1984.

Preliminary results suggest that:

- ratios of steelhead parr to fry in the Nicola mainstem over a four-year period suggest that parr habitats may be limiting and near capacity for

direct smolt production. Estimates of potential for steelhead smolt production in the Nicola River have been revised downward from earlier assessment

- recent sampling results and smolt prediction models together suggest that the Spius/Maka system is much closer to its production potential for steelhead than originally estimated. Initial results of post-fry stocking assessment indicates that Maka Creek may receive adequate natural recruitment during most years. Fry densities appear to have increased in upper reaches of Spius Creek since fry releases in 1982 and 1983, but not in Maka Creek

- the greatest potential for increased steelhead production in the Nicola system may be realized by improved recruitment of fry to the upper Coldwater River. Potential for increased steelhead production has been realized in tributaries such as Guichon, Clapperton and Skuhun Creeks. Alternative irrigation practises and flow regulation required prior to fry stocking, however, are extremely prohibitive in terms of cost

- extreme variability in pre-fall outmigration of juvenile chinook has been documented for 1980-83 populations (0-100 percent outmigration). There appears to be a strong relationship, not evident from earlier data, between size and outmigration. The assessment of habitat capability for chinook requires an earlier assessment of habitat quantity. High flow refuge habitat may ultimately limit juvenile chinook production

- coho populations in the Nicola River appear to have been virtually eliminated, while remnant populations were found in Maka Creek and the upper Coldwater River. Limited recruitment is suspected to be the major problem for juvenile coho production.

This fourth year of habitat capability assessment and followup assessments of fry stocking has indicated there should be changes in present enhancement strategies; in particular, the fry stocking program on Spius Creek.

Contact: Dale Sebastian, Fisheries Biologist, Fish Habitat Improvement Section, Fish and Wildlife Branch, Victoria.

Deadman River Gravity Flow Diversion Screen

Deadman River enters the Thompson River several kilometers downstream of Savona.

The Deadman is a major salmonid-producing stream for the Thompson River. Annual steelhead escapements are up to 500 fish: chinook 100 to 400, coho 100 to 200. An old irrigation ditch diverting flows onto the Deadman Indian Reserve was put back into operation in spring 1983. Significant numbers of salmonid juveniles of varying age classes were observed in the irrigation ditch during 1983. As ditch flows average 2 to 4 cfs, it was decided to install a gravity flow diversion screen in the ditch to divert fry back into the mainstem.

With the aid of the Deadman River Indian Band a diversion screen was installed in the ditch approximately 1 km downstream of the intake. It is estimated that 80 percent of the fry are now diverted out of the ditch and back into Deadman River.

Deadman River Fencing and Bank Revegetation

The Deadman River was defoliated in the early 1900s to grow alfalfa and to provide pasture land for hundreds of cattle. Ranchers in the valley winter cattle along the Deadman River and move cattle to summer grazing ranges in early June. Steelhead spawn in the Deadman River during May while cattle are still wintering in the valley. Unfortunately, cattle move back and forth across the Deadman River, disturbing spawning steelhead and trampling redds. In order to stabilize stream banks and to protect new growth vegetation from grazing cattle, a barbed wire fence was planned.

Red ozier dogwood is the predominant plant species in stable stream areas.

It provides good cover and stability as it overhangs the stream areas. Seeds were collected in the fall of 1982 from red ozier dogwood, Douglas maple, chokecherry and wild rose.

Four km of barbed wire fence were constructed on the Allan property in 1983. The fence was necessary to protect the 2,500 seedlings planted in the spring of 1983 from grazing livestock. These plants had been germinated in a nursery the previous fall and attained a height of 15 cm before planting. A fertilizer tablet was added to every plant to aid in the initial stages of growth.

Thompson River Creel Census

The Thompson River flows from Savona through Ashcroft and Spences Bridge before it joins the Fraser River at Lytton.

The Thompson River creel census has been in operation since 1976, providing regional staff with information to aid in the management of Thompson steelhead. Creel census is also used to monitor marked steelhead returns.

For the first time, creel census activities were contracted out. Regional staff also contributed some time to the creel census.

An estimated 1,560 anglers fished 6,971 angler-days and caught 1,240 steelhead in 1983. Catch per angler day in 1983 was 0.18. Anglers this year released 36.5 percent and killed 63.5 percent of their catch.

British Columbia anglers, including locals, accounted for 86 percent of the season angling effort and 78.9 percent of the reported catch. Anglers from Washington and Oregon had the highest release rate of 53.9 percent, while Canadian non-British Columbia residents reported the highest kill rate at 100 percent. Apparent lower steelhead escapement and poor angling conditions accounted for the lowest recorded catch since 1976.

Creel census personnel checked 17 marked steelhead in 1983. Twelve maxillary clips were identified as returns from fry stockings in the Bonaparte and Deadman Rivers. These fish returned as 1.2+ and 2.1+ year classes. Nose tags were found in four of the five adipose-clipped fish and again were of Deadman and Bonaparte origin.

Steelhead Brood Stock Collection and Fry-Stocking - Spius Creek

Spius Creek flows into the Nicola River downstream of Merritt.

Spius Creek was identified as an area generally undercolonized by juvenile salmonids. Although access is available to most of Spius Creek and its major tributary, Maka Creek, spawner escapement has been minimal in headwater areas. Spius and Maka Creeks have therefore been stocked with fry since 1982. Fry-stockings have increased from 38,000 in 1982 to 82,000 in 1983.

Fifteen steelhead, 12 females and three males, were angled from Spius Creek and transported to Loon Creek hatchery in 1983.

A total of 82,000 fry was stocked into Spius and Maka Creeks, including 3,000 into Prospect Creek, another tributary. Releases were done in early August by truck and helicopter to densities of 0.4 fry/m^2.

Steelhead Brood Collection and Fry Stocking - Bonaparte-Deadman

The Bonaparte River flows through Cache Creek and meets the Thompson River at Ashcroft. The Deadman River meets the Thompson several km downstream of Savona.

The Bonaparte has been stocked with steelhead fry and smolts since 1979. Bonaparte River fry stockings include 18,000 in 1979, 39,000 in 1981, 38,000 in 1982 and 51,000 in 1983. Annual smolt releases are 40,000. Returns are expected to provide increased angling opportunity for the Thompson. The Bonaparte River has an impassable barrier 2 km from its confluence with the Thompson. Fry stockings have been

above the falls and it is hoped that passage past the falls for returning steelhead will be a priority project in the near future. Bonaparte River brood stock is collected from the Deadman River. The Deadman River was stocked in 1980 with 37,000 fall fry.

Brood stock in 1983 was collected entirely from the Deadman River. Fish were transported from the Deadman fence to Loon Creek just prior to peak flows when the fence was pulled. The Deadman fence is a permanent structure located 11 km upstream of the Thompson. A total of 18 females and 16 males was transported. A broomstick fence was operated on the Bonaparte by Loon Creek hatchery staff for two weeks until high flows.

A total of 67,930 fry was stocked in the headwaters of the Bonaparte River. Fry were scatter-released from Rayfield River to Clinton at 0.4 fry/m^2. A fall assessment of seven sites within the release area determined summer-to-fall fry survival to be at least 19 percent, not allowing for migration.

Contact: Ian McGregor, Biologist, Fish and Wildlife Branch, Kamloops.

Bonaparte River Steelhead and Chinook Release Assessment

Stocking of anadromous salmonids (chinook and steelhead) above the barrier falls in the Bonaparte River was initiated in 1979. Steelhead fry and parr, and chinook fry have been released at various sites since that time. Using the 1979 assessment of fish production potential as a base, a release strategy and post-release assessment have been planned. Objectives of the assessment programs were to evaluate success of releases in terms of juvenile rearing and growth and to form a basis for future stocking programs.

In 1983, Bonaparte River chinook and steelhead releases were also assessed.

The 1983 fish release to the Bonaparte River included 34,000 chinook fry, 68,000 steelhead fry and 11,700 steelhead parr (yearlings). Assessment of the various releases was conducted by late summer fish population estimates. Only preliminary data are available as results have not been analyzed; a report is being prepared.

Contact: Dave Tredger, Fisheries Biologist, Fish Habitat Improvement Section, Fish and Wildlife Branch, Victoria.

Chilcotin River Steelhead Stocking

Declining steelhead stocks in the Chilcotin River system have been noted during the past decade. Interception of return runs of adult steelhead by mixed-stock commercial fisheries and overharvesting by anglers have been contributing factors. Very restrictive angling regulations are currently in place.

In 1981 and in 1982, pilot steelhead fry production projects were undertaken at a makeshift hatchery facility located on the T-H Ranch near Hanceville. Approximately 14,000 steelhead fry were liberated in 1981 and 34,000 in 1982. In 1981, fry were released in the Chilko River. In 1982, fry were released in the Little Chilcotin River.

The fry stocking program continued in 1983 with a stated release goal of 100,000 fry. This is a substantial increase over previous efforts. Adult steelhead were collected from the Chilcotin River by angling during April and were held in isolation boxes until ripe. Spawning was done between May 10 and 27.

A total of 136,555 eggs were obtained from 17 female Chilcotin steelhead. Approximately 87,500 fry, averaging 0.34 g, were released into the Little Chilcotin River in three reaches totalling 24 km of habitat.

Fry were released on July 14 by helicopter.

An aerial count of spawners in the Chilko River during May assessed steelhead escapement to the Chilcotin

system. A creel census was also undertaken to provide data on run size and angling effort/success.

The May 13 aerial count of steelhead in the Chilko River was 319. This is substantially higher than the 1982 count of 195. Total escapement to the system in 1983 is not calculable. The higher count is not necessarily indicative of larger overall returns.

Between October 9 and December 3, there were 353 angler days expended in the Chilcotin system and 121 steelhead were landed of which 81 (67 percent) were released.

Unacceptable losses of eggs during incubation were caused by contamination of the water source by livestock in 1983. Heavy silt loads were carried to and deposited on the eggs resulting in suffocation and subsequent fungus growth. The present hatchery site is in a small woodshed and is neither convenient nor large enough. A suitable building and "safe" water intake system will be constructed in 1984. Costs, including additional hatchery equipment, will be approximately $25,000-$30,000.

Approximately 100,000 steelhead fry are to be raised and released into Chilcotin River. Survival and growth assessment are planned in September - October, and a creel survey will be undertaken October - December. Spawning escapement to Chilko River is to be determined by aerial counts in May.

Contact: D. Wilders,
Fish and Wildlife Branch,
Williams Lake.

Little Chilcotin River Steelhead Stocking

Enhancement of Chilcotin River steelhead through fry stocking in the Little Chilcotin River was initiated in 1982 with a release of 34,000 marked steelhead fry. Poststocking assessment indicated a saturation fry density of 3.24 fry/linear m (0.12 fry/m^2). Release density sufficient to saturate the stream was estimated at 4 to 4.7 fry/linear m (0.15 to 0.17 fry/m^2). Total fry requirement for the Little Chilcotin was estimated at 110,000. Poor growth of hatchery fry suggested that future releases be conducted earlier in the summer when instream growth conditions are better.

Results of the 1982 assessment program provided the basis for 1983 fry release planning. A total of 87,500 Chilcotin River steelhead fry were released to the Little Chilcotin River in July 1983 in accordance with suggested densities. Objectives of the 1983 assessment program were to determine fall fry density, growth and survival rates, and to discuss results in terms of optimum stocking strategy through comparison with 1982 results.

Assessment of a steelhead fry release to the Little Chilcotin River was conducted in September 1983. Of the 87,500 fry released, 43,000 (0.37 g) fry were released to a study area on July 14, 1983, at a density of 4.7/m of stream (0.17 fry/m^2). Survival of these fry to the fall was estimated at 30 percent. Mean density was 1.75 fry/m of stream (0.6 fry/m^2). Growth slope (Gs x 1000) from release to assessment ws 12.5, for a final size of 3.48g.

Comparison of the 1983 release was made with the August 27, 1982 release of 37,000 fed (0.86 g) fry at 27 fry/m (1.0 fry/m^2). Results indicated better growth for 1983 releases as evidenced by higher growth slope values (12.5 vs 3.4 in 1982). Mean fry density was significantly lower in 1983, while total fry biomass was higher (though not significant statistically) in 1983. Survival of fall 1982 fry to fall 1983 yearlings indicates survival in the order of three times greater for larger hatchery and wild fry. The 1983 release was viewed as "more successful" by providing a larger fall fry, which is suspected of translating to greater smolt yield through increased overwinter survival and younger average smolt age.

Steelhead fry stocking in the Little

Chilcotin River will continue. Assessment of fry stocking programs to fine-tune the strategy will be conducted only as opportunities present themselves.

Contact: Dave Tredger, Fisheries Biologist, Fish Habitat Improvement Section, Fish and Wildlife Branch, Victoria.

Chilko River Steelhead Fry Recruitment Monitoring

The Chilko River is 90 km west of Williams Lake.

The Chilko River is the major spawning area for Chilcotin River steelhead. Assessment of steelhead fry recruitment in the Chilko relative to potential carrying capacity was initiated in 1981 and was monitored again in 1982. Estimates of fall steelhead fry population ranged from 600,000 in 1981 to 304,000 in 1982. In September 1983, a third consecutive year of fry population monitoring was conducted. Objectives of the program were to estimate the steelhead fry population, and to discuss annual population trends in terms of indicators of adult escapement.

Sampling at eight index sites in the Chilko River produced a population estimate of 598,000 steelhead fry in September 1983. This estimate was approximately equal to the 1981 fry population estimate of 601,000 and roughly double the 1982 estimate of 304,000.

No pattern was found in relating fry population trends to indicators of adult escapement (e.g. steelhead harvest analysis, regional creek census and aerial spawner counts) in the three years of study.

Additional work is required in calibration of adult escapement indicators to fall fry populations. Adult census is an ongoing regional program.

Initial assessment of the Chilko River steelhead fry population (Tredger 1982a) indicated a population very near to suspected saturation levels. The need for hatchery steelhead fry introductions to the Chilko River was questioned, and the program was shifted to colonize known under-recruited areas in the Chilcotin River system.

Contact: Dave Tredger, Fisheries Biologist, Fish Habitat Improvement Section, Fish and Wildlife Branch, Victoria.

Middle Shuswap River Outplant Evaluation

This evaluation involves the middle Shuswap River from Sugar Lake to Mabel Lake northeast of Lumby. Tributaries included in the assessment were Bessette, Duteau, Harris, Creighton, Cherry and Rieter Creeks.

A small hydroelectric plant (Wilsey Dam) at Shuswap Falls prevents anadromous fish from gaining access to 31 km of the middle Shuswap River. In 1977, adult chinook were transplanted above the falls to assess suitability of the area for spawning. Transplanting of adults was rejected as a viable enhancement technique due to difficulty in capturing adults and mortalities due to handling. In 1978, the potential impacts of chinook introduction on existing resident trout populations were investigated. In 1983, outplanting opportunities for chinook and coho in the middle Shuswap River and tributaries were evaluated. Objectives were to ensure that complete habitat and fish information (all species) was collected which would enable a habitat capability assessment for salmonids; in particular, for juvenile chinook and coho, but also for rainbow trout. The primary interest was to collect data which could be used to further assess the potential impacts of chinook and coho outplanting on resident gamefish populations.

This project involved two field assessments; at moderate flow during July and at low flow during September. The purpose was to quantify usable habitat area at different flows and to investigate summer migration behavior in juvenile chinook. Results suggested that:

- significant numbers of juvenile chinook remained until mid-summer before outmigrating. Early stream rearing appears to be important for chinook survival
- populations of juvenile chinook below Shuswap Falls were significantly reduced by late summer, suggesting a major outmigration occurred prior to September. Low densities of chinook in September suggest outmigration is behavioral and not necessarily habitat related (i.e. not necessarily density dependent)
- because of outmigrations, high flow habitat areas of approximately 30 ha below Shuswap Falls and 13.5 ha above, appear to be more limiting to potential chinook production than late summer habitat areas of only 1.3 and 0.4 ha below and above the falls, respectively
- both velocity and cover become more limiting to juvenile chinook and coho production upstream from Shuswap Falls. Habitats are more favorable for trout than for chinook production in Cherry and Reiter Creeks, and in the middle Shuswap River upstream of Cherry Creek confluence
- opportunities exist for outplanting approximately 190,000 chinook fry at 2 g size above Shuswap Falls. Outplanting below Shuswap Falls should not be necessary with increased escapements to the lower river
- potential for enhancing coho production exists primarily in Bessette Creek, and secondarily in the middle Shuswap River below Shuswap Falls. An outplant of 100,000 unfed fry to Bessette Creek was recommended as the best enhancement strategy for coho. Follow-up assessments were recommended for all outplanting.

Contact: Dale Sebastian, Fisheries Biologist, Fish Habitat Improvement Section, Fish and Wildlife Branch, Victoria.

Job Creation Projects

Kanaka Creek

This project provided labor, materials and machine time to aid in the completion of the Kanaka Creek hatchery, near Maple Ridge. The facility will serve primarily as an educational facility for the public and organized groups, while striving to increase the salmonid populations of Kanaka Creek and nearby watersheds.

The 17 workers were involved in a number of activities:
- completion of site drainage
- construction of interpretive trails and signs
- upgrading of access roads
- construction of parking area, fence and signs
- site landscaping
- fabrication and installation of reservoir covers
- modifications to water intake
- aid in operation and maintenance of fish fence/trap.

The hatchery is operated by volunteers and a hatchery manager who is under contract to SEP's public involvement program.

Inch, Birkenhead, Tenderfoot Hatcheries Project

This project provided extra labor for operation of the three facilities. The ten people were employed in landscaping, construction and general hatchery operations.

Mission-Hope Spawner Escapements

This project, located in the lower Fraser River region between Mission and Hope and between the Fraser River and the north end of Harrison Lake, had as its main objective the inspection of all salmonid-bearing streams and enumeration of spawners in the area.

The six employees surveyed nearly 70 streams and also cleared obstructions which were impeding upstream migration of salmon.

Seton/Bridge River Facilities Maintenance

This project, directed by the International Pacific Salmon Fisheries Commission (IPSFC), saw six people hired from the Lillooet area. They cleaned debris and weed growth from the Seton River spawning channels and the Bridge

River fishway. The efforts should pay off in increased productivity and a longer lifespan for these facilities.

Contact: Colin Masson, Project Coordinator, Special Projects Division.

Table 7

Public Participation Projects

FRASER RIVER PUBLIC PARTICIPATION PROJECTS

Location	Name of Group	No. of People Involved in 1983	No. of Years Group Involved in SEP	Type of Project	Species	Juveniles Released	% Survival	Expected Adult Production from 1983 Releases
Nicomekl R.	George Derkson	8	4	incubation	coho	6,000	57	72
Salmon R.	Joe Hopink	12	4	incubation	coho	30,000	60	360
Little Campbell R.	Semiahmoo Fish & Game Club	25	6	studies, construction	coho steelhead chinook chum	Tagging of downstream migrant smolts; captured brood stock for Abbotsford trout hatchery.		
Hyland Cr.	K.B. Woodward Elementary School	150	3	incubation in school	coho	1,200	50	14

Location	Name of Group	No. of People Involved in 1983	No. of Years Group Involved In SEP	Type of Project	Species	Juveniles Released	% Survival	Expected Adult Production from 1983 Releases
Serpentine Fen	Surrey Fish & Game Club	20	5	incubation, stream improvement	coho	4,000	16	2
Chilliwack River	Center Creek Corrections Camp	20	3	incubation	cutthroat	17,000	81	680
Chilliwack Area Streams	Chilliwack Senior Secondary School	50	3	incubation in school	coho coho	50,000 7,200	— 90	6 86

Contact: Joe Kambeitz, SEP Community Advisor.

Mossom Creek	Centennial High School	15	8	incubation	chum	2,000	3	16
Brunette River	Sapperton Rod & Gun Club	12	5	incubation, stream improvement, fish-ways, construction	coho	High mortality of eggs due to vandalism. Fry incubated and reared at Alouette River hatchery. 15,000 smolts to be released.		
Kanaka Creek	Greater Vancouver Regional District/The Sun	20	2	incubation, rearing, information	coho chum steelhead	Rearing 16,000 to smolt stage. 4,000 Rearing 7,000 to smolt stage.	80	32
Silvermere Lake	Silverdale Elementary School	30	3	incubation, construction	chum	30,000	97	240
Silverdale Creek	Sun Valley Trout Farms	2	4	incubation, stream improvement	chum	20,000	80	160

Contact: Gary Taccogna, SEP Community Advisor.

Bessette Creek	Lumby and District Wildlife Association	30	4	incubation	coho	3,000	15	36
Tappen Creek	Salmon Arm Secondary School	—	6	incubation	coho	50	1	1
Shuswap River	Kingfisher Community Club	25	3	incubation	chinook	27,000	89	162
Louis Creek	Fins Fish in Natural Setting	14	2	incubation	coho	6,300	89	76
Barriere River	David Smith	3	2	incubation	coho	17,000	43	255
Cook Creek	Blue River Lioness Club	—	5	incubation	coho	2,000	50	24
Lemieux Creek	North Kamloops Elementary School	10	4	incubation	coho	1,500	50	18
Nicola River	Merritt Rod & Gun Club	6	3	incubation	coho	7,000	70	84
Yalakom River	Lillooet Secondary School	50	5	incubation	chinook	18,000	86	263
Chilako River/ Hutda Lake	Hutda Lake Corrections Camp	85	3	incubation	coho	50,000	79	600
Nechako River	Spruce City Wildlife Association	100	6	incubation	sockeye	6,500	81	98
					chinook	100	1	1
					sockeye	9,000	86	135

Contact: Dennis Damontier, SEP Community Advisor

Table 8

Fraser River SEP Facilities*: Juvenile Releases 1983

Species	Brood	Group	Total Released	% Marked	% Survival	Average Size(g)
Inch Creek Hatchery						
Chum	1982	Stave	665,688	5	N/A	1.10
Chum	1982	Stave	827,084	4	N/A	1.31
Chum	1982	Stave	717,492	5	N/A	1.63
Chum	1982	Inch	2,512,159	4	N/A	1.00
Chum	1982	Blaney	568,229	0	N/A	1.20
Coho	1982	Nicomen	79,311	93	N/A	9.00
Cutthroat	1982	Inch	8,590	100	N/A	81.00
Cutthroat	1982	Inch	4,000	100	N/A	41.00
Cutthroat	1982	Stave	13,150	100	N/A	41.00
Alouette River Hatchery						
Chum	1982	Alouette	93,756	100	80	2.8
Steelhead	1982	Alouette	40,000	100	90	80.0
Fraser Valley Trout Hatchery						
Not available at time of printing.						
Chilliwack River Hatchery						
Steelhead	1983	Chilliwack	101,458	0	N/A	3.5
Steelhead	1982	Chilliwack	118,774	100	86.2	68.0
Steelhead	1982	Chilliwack	10,655	0	N/A	2.0
Chinook	1982	Harrison	1,120,729	6.6	73.7	6.9
Chum	1982	Chilliwack	4,152,553	4.8	80.8	1.10
Coho	1981	Post	107,118	42.1	76.8	18.4
Coho	1982	Post	63,653	0	92.4	0.25
Coho	1981	Dolly Varden	137,539	21.5	72.1	19.0
Coho	1981	Salwein	22,829	87.6	17.6 [1]	19.8
Coho	1981	overflow	31,516	95.2	58.2	19.9
Chehalis Band Project						
Chinook	1982	Harrison	70,000	0	N/A	2.0
Chum	1983	Harrison	2,088,000	0	N/A	0.5
Chehalis River Hatchery						
Chinook	1982	Harrison	683,630	22.2	54.8	5.5
Chum	1982	Harrison	5,262,868	N/A	90.9	1.1
Chum	1982	Chehalis	1,107,307	N/A	93.6	1.3
Chum	1982	Weaver	550,110	15.8	89.9	1.2
Chum	1982	Squakum	1,343,667	5.7	92.0	1.3
Jones Creek Spawning Channel						
Not available at time of printing.						
Birkenhead River Hatchery						
Chinook	1982	Birkenhead	44,161	100	N/A	1.4
Chinook	1982	Birkenhead	42,831	100	N/A	2.2
Chinook	1982	Birkenhead	29,207	100	N/A	3.5
Chinook	1982	Birkenhead	25,336	0	N/A	1.0

*Includes facilities constructed prior to SEP.
N/A means "not available."
[1]Extreme losses due to coagulated yolk in incubation and early rearing.

Table 8 (Cont'd)

Species	Brood	Group	Total Released	% Marked	% Survival	Average Size(g)
Eagle River Hatchery						
No releases in 1983. First egg-take in the fall.						
Loon Creek Hatchery						
Chinook	1982	Bonaparte	34,400	83	N/A	3.62
Louis Creek Coho Hatchery						
Not available at time of printing.						
North Thompson Band Project						
Coho	1982	Dunn	25,291	64	N/A	5.7
Quesnel River Hatchery						
Chinook	1982	Bowron	334,983	90.0	82.9	3.20
Chinook	1982	Slim	498,181	20.5	85.0	2.62
Chinook	1982	Blackwater	39,477	95.2	55.4	2.86
Chinook	1982	Nazko	387	0	10.8	1.78
Chinook	1982	Quesnel	509,918	81.6	88.5	2.30
Penny Pilot Hatchery						
Chinook	1982	James	178,126	40.6	90	1.5
Stuart River/Necoslie Band Project						
No releases in 1983. First egg-take in the fall.						

Table 9

Fraser River SEP Facilities: Status at December 1983*

Species	Stock	Brood	Stage	No. on Hand	Expected Release Date	Number	Site
Inch Creek Hatchery							
Chum	all stocks	83	egg	4,908,000	This information not available at time of printing.		
Chum	Inch	83	egg	480,500			
Chum	Blaney	83	egg	748,000			
Chum	Stave	83	egg	4,160,000			
Coho	all stocks	83	fry	214,000			
Coho	Inch	83	fry	70,600			
Coho	Nicomen	83	egg	6,230			
Coho	Nicomen	83	fry	61,600			
Coho	Siddle	83	fry	19,800			
Coho	Norrish	83	fry	32,400			
Coho	Blaney	83	egg	11,300			
Cutthroat	Whonnock/ Silverdale	83	fry	29,600			

Table 9 (Cont'd)

Species	Stock	Brood	Stage	No. on Hand	Expected Release Date	Number	Site
Alouette River Hatchery							
Chum	Alouette	83	egg	342,726	April 1984	340,000	Alouette
Coho	Alouette	82	smolt	35,627	June 1984	35,000	Alouette
Coho	Alouette	83	egg	5,500	June 1985	5,000	Alouette
Coho	Brunette	82	smolt	40,000	June 1984	40,000	Brunette
Pink	Harrison	83	egg	792,175	March 1984	700,000	Alouette
Steelhead	Alouette	83	fry	28,000	May 1984	28,000	Alouette
Fraser Valley Trout Hatchery							
Not available at time of printing.							
Chilliwack River Hatchery							
Coho	Chilliwack	83	egg/ alevin	610,000	May 1984	460,000	Chilliwack
Coho	Chilliwack	83	egg	2,108,688	May-June 1984	2,003,000	Chilliwack
Chilliwack River Hatchery (Cont'd)							
Coho	Salwein	82	fingerling	92,842	May-June 1984	92,000	Chilliwack
Coho	Dolly Varden	82	fingerling	154,709	May 1984	154,000	Dolly Varden Creek
Coho	overflow	82	fingerling	303,000	May 1984	302,800	Chilliwack
Chum	Chilliwack	83	egg	1,650,000	April 1984	1,500,000	Chilliwack
Chinook	Harrison	83	egg	1,207,300	June 1984	1,152,000	Chilliwack
Steelhead	Chilliwack	83	fingerling	135,000	May 1984	134,900	Chilliwack
Chehalis Band Project							
Chum	Harrison	83	egg	14,342,262	May 1984	7,768,477	Harrison
Chehalis River Hatchery							
Chinook	Harrison	83	egg	4,573,227[1]	May-June 1984	1,900,000	Chehalis
Chum	Harrison	83	egg	10,997,389	March-June 1984	9,897,651	Harrison
Chum	Chehalis	83	egg	3,140,974	March-June 1984	2,826,877	Chehalis
Chum	Weaver	83	egg	550,854	April-May 1984	495,769	Chehalis
Chum	Squakum	83	egg	746,158	April-May 1984	671,542	Squakum
Coho	Harrison	83	egg	19,800	May 1985	17,820	Harrison
Coho	Chehalis	83	egg	342,597	May 1985	308,337	Chehalis
Coho	Squakum	83	egg	2,698	May 1985	2,428	Squakum
Coho	Weaver	83	egg	320,140	May 1985	288,126	Weaver
Coho	Hicks/Maria	83	egg	11,750	May 1985	10,575	Hicks/Maria
Coho	Evans	83	egg	26,560	May 1985	23,904	Evans
Coho	Coho	83	egg	54,900	May 1985	49,410	Coho
Coho	Eagle	83	egg	10,000	May 1985	9,000	Eagle
Coho	Harrison	82	presmolt	68,960	May 1984	68,900	Harrison
Coho	Chehalis	82	presmolt	26,935	May 1984	26,900	Chehalis
Coho	Weaver	82	presmolt	188,450	May 1984	187,800	Weaver

Table 9 (Cont'd)

Species	Stock	Brood	Stage	No. on Hand	Expected Release Date	Number	Site
Coho	Hicks/Maria	82	presmolt	45,563	May 1984	45,000	Hicks/Maria
Coho	Coho	82	presmolt	84,377	May 1984	84,300	Coho
Coho	Evans	82	presmolt	70,579	May 1984	70,500	Evans
Cutthroat	Harrison	82	presmolt	5,920	May 1984	5,900	Harrison
Steelhead	Chehalis	82	presmolt	6,473	May 1984	6,450	Big Silver
Steelhead	Chehalis	82	presmolt	40,656	May 1984	40,600	Chehalis
Steelhead	Weaver	82	presmolt	35,649	May 1984	35,600	Weaver, Big Silver, Cogburn
Jones Creek Spawning Channel							
350 adult pink salmon in channel.							
Birkenhead River Hatchery							
Chinook	Birkenhead	83	alevin	154,000	April 1984	150,000	Birkenhead
Coho	Birkenhead	83	egg	28,000	Sept. 1984	27,000	Birkenhead
Eagle River Hatchery							
Chinook	Eagle	83	egg	127,000	Spring 1984	N/A	Eagle
Coho	Eagle	83	egg	425,000	Spring 1984	N/A	Eagle
Coho	Salmon	83	egg	200,000	Spring 1984	N/A	Salmon
Loon Creek Hatchery							
Chinook	Bonaparte	83	egg	41,900	May 1984	N/A	Bonaparte
Chinook	Deadman	83	egg	41,700	May 1984	N/A	Bonaparte
Louis Creek Coho Hatchery							
Coho	Louis	83	egg	30,000	May 1984	N/A	Louis
North Thompson Band Project							
Coho	Dunn	83	egg	56,898	July 1984	55,000	Dunn
Coho	Lemieux	83	egg	57,000	July/ October 1984	33,000	Lemieux
						23,000	Lemieux
Quesnel River Hatchery							
Chinook	Blackwater	83	fry	257,165	April 1984	256,000	Blackwater
Chinook	Bowron	83	fry	440,225	April 1984	438,400	Bowron
Chinook	Cariboo	83	fry	84,888	April 1984	83,000	Cariboo
Chinook	Horsefly	83	fry	23,462	April 1984	23,300	Horsefly
Chinook	Indian Point	83	fry	86,958	April 1984	86,400	Indian Point
Chinook	Nazko	83	fry	163,346	April 1984	161,900	Nazko
Chinook	Quesnel	83	fry	439,944	April 1984	436,000	Quesnel
Coho	McKinley	83	egg	22,669	April 1984	19,450	McKinley
Penny Pilot Hatchery							
Facility ceased operations after releases.							
Stuart River/Necoslie Band Project							
Chinook	Stuart	83	egg	53,000	April 1984	52,000	Stuart

*Includes facilities constructed prior to SEP.
N/A means "not available."
[1]1,470,812 chinook eggs transferred to Chilliwack River hatchery; 39,414 chinook fry to the Stave River project.

Table 10

Fraser River SEP Facilities*: Surplus Sales 1983

Species	Pieces	Eggs (number)	Native Food Fish (pieces)	Value ($)
Chilliwack River Hatchery				
Coho	241	0	0	200.00
Coho	0	140,000	0	--
Chum	0	10,000	0	--

*Includes facilities constructed prior to SEP.

Table 11

Fraser River SEP Facilities*: Escapement to Facility 1983

Species	Escapement to Facility	Spawned for Hatchery Stock male	Spawned for Hatchery Stock female	% Marked male and female
Inch Creek Hatchery				
Chum	5,500	462	881	2.0
Coho	250	43	61	12.4
Chilliwack River Hatchery				
Chinook (jacks)	1,344	5	0	25.6
Chinook (adults)	2	1	1	0.0
Coho (jacks)	1,975	0	0	32.1
Coho (adults)	3,759	1,441	1,331	70.0
Chum	365[1]	671+	726	6.3
Birkenhead River Hatchery				
Chinook[2]	--	29	52	0.0
Coho[2]	--	6	10	0.0

*Includes facilities constructed prior to SEP.
[1]In addition to these, more brood stock was captured in the river.
[2]Brood stock was captured by angling for chinook, by angling/gillnet for coho.

Table 12

Fraser River SEP Facilities*: Adult Production

Species	Expected Production from 1983 Releases: Total Adult Production	Years of Return	Contribution to Fisheries	At Full Production: Total Adult Production	Contribution to Fisheries
Inch Creek Hatchery					
Not available at time of printing.					

Table 12 (Cont'd)

Species	Expected Production from 1983 Releases: Total Adult Production	Years of Return	Contribution to Fisheries	At Full Production: Total Adult Production	Contribution to Fisheries
North Thompson Band Project					
Coho	3,794	1985	2,086	13,500	7,425
Quesnel River Hatchery					
Chinook	30,425	1985-1987	24,888	55,000	45,045
Penny Pilot Hatchery					
Chinook	1,336	1985-1987	1,094	N/A	N/A
Stuart River/Necoslie Band Project					
No releases in 1983.					
Alouette River Hatchery					
Chum	1,875	1985-1987	825	20,000	8,800
Steelhead	95	1985-1988	47	1,000	500
Fraser Valley Trout Hatchery					
Not available at time of printing.					
Chilliwack River Hatchery					
Not available at time of printing.					
Chehalis Band Project					
Chinook	2,104	1988	1,683	N/A	N/A
Chum	1,670,156	1985-1988	734,869	N/A	N/A
Chehalis River Hatchery					
Chinook	20,509	1984-1987	18,233	65,000	58,000
Chum	165,279	1985-1986	123,959	200,000	150,000
Coho	--	--	--	64,000	48,000
Steelhead	--	--	--	5,000	4,000
Cutthroat	--	--	--	5,000	3,000
Jones Creek Spawning Channel					
Not available at time of printing.					
Birkenhead River Hatchery					
Not available at time of printing.					
Eagle River Hatchery					
No releases in 1983.					
Loon Creek Hatchery					
Not available at time of printing.					
Louis Creek Coho Hatchery					
Not available at time of printing.					

*Includes facilities constructed prior to SEP.
N/A means "not available."

1

West Coast Vancouver Island

1. *Divers check spawning chinook on the lower Kennedy River.*
2. *A Small Projects engineer gets down to work at the San Juan project.*

2

West Coast Vancouver Island

San Juan Enhancement Society Project

This project is located on Four Mile Creek, a tributary of the San Juan River, near Port Renfrew. Its purpose is to enhance wild stocks of chinook, coho, sockeye and chum in the San Juan watershed.

The project began in 1977 and was operated as a volunteer project for three years. In 1980, it became a community economic development project and it continues so to this day. The project provides employment for one person on a full-time basis and for one part-time employee. Some members of the community are trained in the fish culture aspects of a small-scale hatchery. Volunteers collect the brood stock for the hatchery.

The hatchery was operated through 1983, incubating and rearing chinook, coho, sockeye and chum salmon. The hatchery production is contributing to the commercial troll fisheries on the west coast of Vancouver Island.

The facilities were improved in 1983 by the construction of two wells to be used as backup systems and by the purchase of extra Heath trays and a header tank. The total egg capacity is 2,000,000; rearing space is the limiting factor.

The hatchery expects to continue its incubation and rearing activities in 1984 with emphasis put on chinook production. Smolt traps will be constructed to aid in determining timing of coho outward migration, growth and survival rates.

Contact: Barry Cordocedo,
Project Coordinator,
Special Projects Division.

Nitinat River Hatchery

Nitinat River hatchery is located at the confluence of the Nitinat and Little Nitinat Rivers, approximately 60 km southwest of Port Alberni.

This Japanese-style hatchery was designed to incubate 28 million chum eggs and 1.5 million chinook eggs incubated in Heath trays.

In 1983, along with the production of 8.4 million chum fry, 2.4 million chinook smolts and 63,000 coho presmolts, three experiments were conducted. These involved low versus high keeper pond velocities, low versus high chum rearing densities and colonizing the headwaters of barren streams in the Nitinat system with coho. The results of these experiments will be evaluated on the basis of returning marked adults.

The escapement of chum and chinook to Nitinat in the fall of 1983 was again less than optimum even without a terminal fishery. Despite this, 19 million chum, 2.9 million chinook and 35,000 coho eggs were collected. Since chinook require more rearing space than chum, these numbers will essentially fill the hatchery to capacity.

It is anticipated that the first commercial fishery on enhanced chum will take place in fall 1984.

Contact: Colin Harrison
Stock Enhancement Officer,
Enhancement Operations.

Robertson Creek Hatchery

Robertson Creek hatchery is both a production and a research-oriented facility located near the outlet of Great

Central Lake, approximately 15 km northwest of Port Alberni. The facility started out in 1959 as a spawning channel for pink salmon. When it was officially opened in 1960 it was reported to be the largest artificial spawning channel in North America. Its main purpose was to introduce pink salmon into the Somass River system. It was also to build up runs of chinook and coho.

A pilot hatchery was set up in 1972 and later expanded with the objective of enhancing Robertson Creek chinook and steelhead stocks. The success of this project has led to several expansions of the facility over the years, and a terminal net fishery was established in 1978 in the Alberni Inlet to catch excess chinook returning to the hatchery.

The hatchery has also been active in research, notably in a project to restore chinook production to Nahmint River.

Japanese Keeper Channels for Chinook

Keeper channels have been used for the third year now for chinook incubation. The experimental design presently in use appears very promising. A total of 1,653,200 chinook eggs were used for a keeper channel experiment. This experiment involved two gravel sizes of 5.1 to 7.6 cm and 7.6 to 10.2 cm and three different load rates (10,000 per m^2, 12,500 per m^2 and 15,000 per m^2). Generally, the larger gravel in a single layer proved most successful.

Chinook Diet Experiment

In spring 1983, an experiment was designed at Robertson Creek to compare the performance of four prepared fish foods ranging from 8 to 28 percent moisture by weight. Performance was compared on the basis of accumulated growth, fish health, ease and expense of storage and cost. The foods included were Oregon Moist (28 percent moisture), Bio Diet (20 percent), Oregon Semi Moist (14 percent) and West Van (8 percent).

All groups (60,000 fish in each), were ponded from pooled eggs on March 29 into identical concrete raceways, with upwelling surface water. The temperature ranged from 7°C (at ponding) to 15°C (at release). All groups were fed the test rations by hand and to satiation throughout the rearing period. None of the test groups were replicated.

Thirty percent of all groups were coded-wire tagged on May 9 and 10, and were given release access on May 27.

This experiment will be duplicated in spring 1984 on a scale twelve times as large as in 1983.

Nahmint River Chinook Satellite

In fall 1983, the Nahmint River was seined for brood stock. The resulting eggs were incubated at Robertson Creek. Presmolts will be released back to Nahmint River in spring 1984.

Although very low water conditions followed by extreme flooding made brood stock collection difficult, 16 females were spawned for a green egg inventory of 68,070. High mortality (of unknown cause) in incubation (53.2 percent) resulted in a ponding estimate of 49,784. All fry will be coded-wire tagged prior to release and adult returns will be monitored.

Public Participation Projects

The Alberni Volunteer Enhancement Group was given 118,800 coho eggs to be incubated in Atkin cells and hatched in keeper channels at Robertson Creek, prior to release in tributaries of the Stamp River system.

The Ucluelet Volunteer Group, through the local SEP community advisor, was given 100,000 coho eggs for incubation; resulting fry will be released in streams near Ucluelet. The Thornton Creek hatchery, a community economic development project, was given 50,000 coho eggs and 100,000 chinook eggs for incubation.

Bulk Box Incubation

Ten bulk box incubators (80x60x50

cm) are being used in experimental trials using plastic substrate to incubate alevins. The boxes are arranged in five sets of two. Alternate layers of a plastic substrate media and eyed chinook eggs are placed in the boxes. As the eggs hatch, alevins are able to incubate, with the plastic media giving mechanical support. This year, various tests were performed with different alevin densities and with horizontal sectioning of the boxes to obtain a more even vertical distribution of alevins. These techniques are in the developmental stages and results have been mixed.

Sport Fishery Contribution

The contribution of the sport fishery is of major importance to the Alberni Valley. Port Alberni has claimed the title of "Salmon Capital of the World" and hosts a very large chinook derby annually with over $7,000 in prizes. In 1983, 1,144 chinook were weighed in by fishermen in this three-day derby, with a total weight of 8,459 kg or an average weight of 7.4 kg.

Public Awareness

Robertson Creek hatchery has joined with the public to allow them firsthand awareness of the salmon resources. The hatchery has a "drop in" volunteer program which is quite successful. It also incubates coho within the school system to help educate younger people. Hatchery staff provide information during the annual fishing derby and local fall fair. This program is very successful and is welcomed by the public.

Contact: Don Lawseth,
Stock Enhancement Officer,
Enhancement Operations.

Thornton Creek Hatchery

This project is located at the mouth of Thornton Creek near Ucluelet and is operated by the Thornton Creek Enhancement Society, under contract to SEP.

The objective of the hatchery is to enhance the wild chum, coho and chinook stocks in the area, particularly in the Kennedy River system. In addition, chinook and coho from Robertson Creek hatchery have been transplanted to try to establish a sport fishery in this area.

The project employs two people full-time and also provides some seasonal work and training in fish culture to community members.

In 1983, the hatchery continued its regular operations and also completed the second year of a three-year chum sterilization program. The objective of the sterilization program is to develop a larger salmon that remains available to the fishery for a longer period of time. Sterile fish do not mature sexually and therefore their migration to fresh water to spawn is delayed or prevented.

In 1983, 125,000 chum fry were sterilized and a matching 125,000 became a control group. During the alevin stage, the experimental group was sterilized by being dipped in a testosterone MT and alcohol ETOH bath for two hours at a time, once a week for eight consecutive weeks. Fifty thousand from each group were tagged with 1/2-length coded-wire tags before they were released.

Bioreconnaissance work in local streams was carried out by summer students for the second year.

The hatchery plans to continue incubation and rearing activities in 1984, and to complete the chum sterilization program.

Contact: Barry Cordocedo,
Project Coordinator,
Special Projects Division;
Richard Smith, Thornton Creek Hatchery.

Tlupana Inlet/Conuma Hatchery

Conuma River hatchery is the major enhancement facility on northern Vancouver Island's west coast. It is built to standards developed over the past half-century by Japanese re-

search. Located between Gold River and Tahsis at the head of Tlupana Inlet, the hatchery uses Conuma River water and well water to incubate eggs taken from five streams flowing into the inlet. In 1983, its fifth year of production, 20.7 million chum (1 g size) 486,000 chinook and 140,000 coho fry (4.7 g) were released in their streams of origin during the spring and summer. This was a complicated program of releases involving helicopter transport to the more distant streams coupled with truck transport to local streams.

For the second year, coho releases included 80,000 fin-clipped and nose-tagged fry released to reaches of the upper Conuma inaccessible to adults. Survival and migration of these experimental colonists will be monitored during a downstream trapping program in spring 1984. The remaining coho were differentially marked and released into the lower Conuma in September.

Chinook Returns

Returns of four-year-old hatchery chinook to Conuma River increased sufficiently in 1983 to provide all 550,000 eggs required for the chinook enhancement quota on the system. Brood stock was captured in the river proper as in previous years, since few fish of any species showed interest in ascending the hatchery fishway.

Collection Techniques

Two methods of brood stock capture were employed with great success during the chum egg-take. The majority of eggs for some streams in the project were taken from adults caught in river beach-seine sets, but a significant number of adults were also provided by seining in the terminal marine approaches to streams. Analysis of data collected in the two years prior to 1983 indicated that high egg-to-fry survival could be maintained in eggs from adults held in sea pens provided holding time did not exceed 7 - 10 days. By following this guideline and by fertilizing eggs with sperm from river-caught males only, a satisfactory means of exploiting the potential of egg collection from adults held in sea pens was devised. In all, 20.7 million chum eggs were obtained from river and sea-pen operations.

Chum Returns

Although the strong contributions of the efficient brood capture methods were largely responsible for this year's near-capacity operation, the success of the egg-take was founded ultimately on very healthy escapements to four of the five streams covered by the project. Preliminary evaluation of mark recovery data indicates that hatchery ('78 - '79 release) fish constituted upwards of 30 percent of the Conuma River chum escapement and slightly less than 30 percent in other streams. Estimates of hatchery returns to all five streams in 1983 were placed at 66,000 fish. This should increase to 100,000 in 1984 and may allow an in-shore commercial fishery on Tlupana Inlet chum stocks. In line with SEP policy of mitigating incidental catches of other species in a major enhanced fishery, indigenous runs of Conuma River chinook and coho are also enhanced. In addition to chinook egg-takes mentioned previously, 195,000 coho eggs were incubated from adults captured in the river in October, airlifted to the hatchery and held in concrete ponds for as long as two months.

Keeper Channel Studies

It is expected that Conuma River hatchery in its final operating form will be a production hatchery supporting a commercial fishery, but research and design modification remain important duties at this facility. Based on past studies, larger size gravel was exchanged for that previously used in the keeper-channel phase of chum incubation. More uniform dispersal of newly-hatched alevins and improved subsequent survival of fry should result. Eventually, as understanding of keeper channels grows, channel loading densities may be increased beyond design specifications, thus increasing the total production of chum.

Sperm Viability Studies

Studies on sperm viability following

various holding or storage procedures were done. These generated results with great potential for application in an operation such as Conuma's, where eggs and sperm for the same fish stock are sometimes taken at separate times and places. Results indicated that not only does sperm retain 97 percent of its ability to fertilize eggs after retention in male carcasses for up to 1 1/2 hours at 11°C, but also that viability remains high for 5 - 8 days after removal and storage at 4°C provided the ratio of air to sperm in the container is high. Preliminary studies also show that sperm viability in water-diluted samples may be higher than previously thought. Results from the technique of fertilizing eggs from sea-pen females with sperm from river-caught males were indistinguishable from fertilizations using both eggs and sperm from the river; i.e., to eyed stage, both greater than 95 percent survival.

Upwelling Box Study

The 1982 upwelling box incubation of chinook was scaled up; fifteen boxes were set up in Capilano-style rearing troughs to receive chinook, chum or coho eyed-eggs at various loading densities (up to 100,000) and water flow rates. The findings of this study will be reported in 1984, although the tentative conclusion is that coho alevins fare better than chum or chinook in the plastic saddle substrate used. The upwelling box experiments will continue in the fall of 1984 with the aim of increasing production efficiency of the facilities already on hand.

Projects Planned

Projects anticipated for 1984 will deal with the range of procedures in salmon culture and enhancement practiced at Conuma River hatchery. Habitat utilization by out-planted coho in the upper Conuma will be surveyed with an eye to evaluating the airlift program. Larger floats for deployment of estuary sea pens and egg-take operations are planned for the fall program. During the same period, a test lot of adult coho will be injected with pituitary extract to determine the feasibility of inducing synchronized ovulation in a brood stock which has in the past made it necessary to rear several small lots of fry at different (average) sizes. A further objective will be to possibly double the number of chinook eggs incubated.

Long-term questions to be answered concern the degree and effects of adult chum straying to streams other than their stream of origin, and whether the hatchery must continue to treat each stock as separate and unique during all stages of enhancement. Of equal or greater importance, in terms of weakened stocks, is the question of chinook population size in Muchalat and Tahsis Inlet streams. The coming year may see Conuma River hatchery simplifying some operations with increased use of sea pens while taking on more complex tasks in other areas with enhancement of remote chinook stocks.

Contact: Iain MacLean,
Stock Enhancement Officer,
Enhancement Operations.

Job Creation Projects

Sooke Stream Clearance

Four project workers removed logjams and other obstructions in Sooke-area streams to allow upstream passage of spawning salmon.

Nitinat Area Juvenile Salmonid Distribution

The two employees studied the distribution of juvenile salmonids in the Nitinat area. They organized a system for surveying the tributaries of the Nitinat and Caycuse Rivers and set traps to capture juvenile fish. The trapped salmonids were identified as to species and then measured. On a map, the workers divided each stream into reaches and drew diagrams showing where the traps were set and how each location related to number of fish.

Conuma Hatchery Landscaping

The four-person crew employed in this project landscaped the Conuma hatchery site and built small shelters

to promote the aesthetic value of hatcheries.

Contact: Colin Masson, Project Coordinator, Special Projects Division.

Table 13

Public Participation Projects

WEST COAST VANCOUVER ISLAND PUBLIC PARTICIPATION PROJECTS

Location	Name of Group	No. of People Involved in 1983	No. of Years Group Involved in SEP	Type of Project	Species	Juveniles Released	% Survival	Expected Adult Production from 1983 Releases
Pachena River	Pacific Trollers Assoc.	15	7	incubation	coho	35,000	80	420
Robertson Creek	Alberni Enhancement Society	8	3	incubation	coho	123,000	62	1,460
Pleated Creek	John Howitt Elementary School	6	2	incubation in school	coho	4,000	73	48
Beaver Creek	Beaver Creek Elementary School	30	3	incubation in school	coho	300	9	36
Thornton Creek	Thornton Creek Volunteer Society	30	3	incubation	coho	64,700	91	776

Atleo River/ Anderson Creek	Ahousat Indian Day School, Resource Technology School	4 6	3 2	information, incubation	chum	19,000	88	152

Contact: Bryan Allen, SEP Community Advisor.

Location	Name of Group	No. of People Involved in 1983	No. of Years Group Involved In SEP	Type of Project	Species	Juveniles Released	% Survival	Expected Adult Production from 1983 Releases
Memekay River	Pacific Trollers Assn.	18	7	incubation	coho	84,000	89	2,500
Nequiltpaalis Cr.	Western Forest Products	10	3	incubation	chum	14,500	97	290
Aweisha Creek	Quatsino School	25	3	incubation in school and creek	chum	4,000	80	32
Marble River	Western Forest Products	100	3	incubation	chinook coho chum	205,000 13,800 4,000	95 55 96	4,920 188 80
							27,050 chinook were tagged.	
Goodspeed River	Holberg Community	10	6	incubation	coho	22,500	94	270

Contact: George Bates, SEP Community Advisor.

Table 14

West Coast Vancouver Island SEP Facilities*: Juvenile Releases 1983

Species	Brood	Group	Total Released	% Marked	% Survival	Average Size(g)
San Juan Enhancement Society Project						
Chinook	1982	San Juan/Harris	150,000	33	96	6.5
Chum	1982	Granite Cr.	2,000	0	80	0.4
Coho	1982	San Juan	1,626,839	.03	96	1.0
Sockeye	1982	Granite Cr.	59,000	0	90	0.3
Nitinat River Hatchery						
Chinook	1982	Nitinat	2,421,272	3.4	91.0	5.8
Chum	1982	Nitinat	8,432,138	2.2	92.5	1.1
Coho	1982	Nitinat	63,518	100.0	79.4	3.8
Robertson Creek Hatchery						
Chinook	1982	Nahmint R.	107,868	8	N/A	3.07
Chinook	1982	Robertson Cr.	8,116,680	1	N/A	6.97
Chinook	1982	Robertson Cr.	23,276	85	N/A	3.67
Chinook	1982	Robertson Cr.	22,882	87	N/A	3.48
Chinook	1982	Robertson Cr.	22,977	85	N/A	3.39
Chinook	1982	Robertson Cr.	57,819	35	N/A	5.19
Chinook	1982	Robertson Cr.	58,029	35	N/A	4.08
Chinook	1982	Robertson Cr.	58,687	34	N/A	5.37
Chinook	1982	Robertson Cr.	57,994	34	N/A	4.96
Coho	1981	Robertson Cr.	122,876	34	N/A	20.70
Coho	1981	Robertson Cr.	132,475	32	N/A	17.80
Coho	1981	Robertson Cr.	724,733	6	N/A	23.60
Steelhead	1982	wild-Robertson	18,958	96	N/A	59.75
Steelhead	1982	wild-Robertson	18,960	96	N/A	59.75
Steelhead	1982	wild-Robertson	102,161	94	N/A	61.00
Steelhead	1983	Robertson	9,305	92	N/A	18.70
Steelhead	1983	Robertson	8,566	78	N/A	24.20
Steelhead	1983	Somass	10,453	100	N/A	9.00
Steelhead	1983	Robertson	291,776	0	N/A	.90
Thornton Creek Hatchery						
Chum	1982	Thornton Creek	424,446	0	86	0.4
Chum	1982	control group	96,503	47	86	1.2
Chum	1982	sterilized group	69,051	59	86	1.2
Coho	1982	Staghorn	7,894	0	51	10.0
Coho	1982	Kootowis	36,629	0	40	7.1
Coho	1982	upper Kennedy	14,780	100	46	8.1
Coho	1982	Robertson Hatch.	45,058	60	92	17.6
Chinook	1982	Robertson Hatch.	49,075	51	99	4.8
Chinook	1982	lower Kennedy	12,700	79	63	4.0
Tlupana Inlet/Conuma Hatchery						
Chum	1982	local streams	18,795,400	1.5	98	1.25
Chinook	1982	Conuma	487,210	15.6	99	5.3
Coho	1982	Conuma	79,920	87.0	78	2.47
Coho	1982	Conuma	61,090	62.5	78	14.0

*Includes facilities constructed prior to SEP.
N/A means "not available."

Table 15

West Coast Vancouver Island SEP Facilities*: Status at December 1983

Species	Stock	Brood	Stage	No. on Hand	Expected Release Date	Expected Release Number	Expected Release Site
San Juan Enhancement Society Project							
Chinook	Harris	83	egg	102,300	June 1984	92,070	Harris
Coho	San Juan	83	egg	900,000	May 1984	720,000	San Juan
Sockeye	Granite Cr.	83	egg	27,000	April 1984	21,600	Granite Cr.
Chum	Granite Cr.	83	egg	3,000	April 1984	2,400	Granite Cr.
Nitinat River Hatchery							
Chinook	Nitinat	83	egg	2,685,000	June 1984	2,600,000	Nitinat
Chum	Nitinat	83	egg	17,742,000	April 1984	17,500,000	Nitinat
Coho	Nitinat	83	egg	25,000	July 1984	22,000	Nitinat
Robertson Creek Hatchery							
Chinook	Robertson	83	egg	12,276,000	N/A	N/A	Robertson
Chinook	Nahmint	83	egg	62,309	N/A	N/A	Nahmint
Coho	Robertson	83	egg	1,074,800	N/A	N/A	Robertson
Coho	Robertson	82	fry	1,153,951	N/A	N/A	Robertson
Steelhead	N/A	83	fry	186,000	N/A	N/A	N/A
Thornton Creek Hatchery							
Chinook	Lower Kennedy	83	egg	20,383	June 1984	18,345	Lower Kennedy
Chinook	Robertson Cr.	83	egg	93,333	June 1984	83,999	Thornton Cr.
Chum	Control	83	egg	72,913	April 1984	65,622	Thornton Cr.
Chum	Sterilized	83	egg	72,913	April 1984	65,622	Thornton Cr.
Coho	Staghorn	83	egg	21,567	Sept. 1984	19,410	Staghorn
Coho	Kootowis	83	egg	46,374	Sept. 1984	41,736	Kootowis
Coho	Robertson Cr.	83	egg	49,200	March 1985	36,900	Thornton Cr.
Coho	Robertson Cr.	82	smolt	45,185	N/A	N/A	N/A
Coho	Upper Kennedy	83	egg	87,564	Sept. 1984	78,807	Upper Kennedy
Tlupana Inlet/Conuma Hatchery							
Chinook	Conuma	83	egg	493,000			
Chum	Sucwoa	83	egg	4,500,000			
Chum	Canton	83	egg	902,000			
Chum	Tlupana	83	egg	3,000,000			
Chum	Conuma	83	egg	4,700,000			
Chum	Deserted	83	egg	6,260,000			
Coho	Conuma	83	egg	196,000			

*Includes facilities constructed prior to SEP.
N/A means "not available."

Table 16

West Coast Vancouver Island SEP Facilities*: Surplus Sales 1983

Species	Amount of Fish (kg)	Eggs (number)	Native Food Fish (pieces)	Value ($)
Nitinat River Hatchery				
Chinook	0	50,000	0	--
Chum	0	37,000	0	--
Robertson Creek Hatchery				
Coho	48,334.70	0	0	25,185.77
Chinook	63,342.97	0	0	15,654.73
Mixed[1]	40,550.01	0	0	1,216.51
Coho	0	1,493,000	0	15,000.00
Coho	0	272,000	0	--
Chinook	0	360,000	0	3,600.00
Chinook	0	100,000	0	--
Thornton Creek Hatchery				
Chum	691	0	0	55.28

*Includes facilities constructed prior to SEP.
[1]Coho and chinook sold together.

Table 17

West Coast Vancouver Island SEP Facilities*: Escapement to Facility 1983

Species	Escapement to Facility	Spawned for Hatchery Stock male	Spawned for Hatchery Stock female	% Marked male and female
San Juan Enhancement Society Project				
Chinook	No esc. to hatchery	55	19	14
Chum	No esc. to hatchery	1	1	0
Coho	No esc. to hatchery	433	335	0
Sockeye	No esc. to hatchery	9	9	0
Thornton Creek Hatchery				
Chum	1,656	61	141	6
Chinook (Lower Kennedy)	brood stock	6	4	--
Chinook (Roberston Cr. Ha.)	brood stock	10	20	--
Coho (Upper Kennedy, Kootowis, Staghorn)	brood stock	81	63	--
Coho (Robertson Cr. Ha.)	brood stock	40	90	--
Tlupana Inlet/Conuma Hatchery				
Chinook (Conuma)	435	56	126	32
Chum (Conuma)	40,000	1,196	2,131	3
Coho (Conuma)	410	50	60	--
Chum (Canton)	4,000	164	448	1
Chum (Sucwoa)	16,000	1,280	2,254	6
Chum (Deserted)	25,000	3,783	3,000	2.6
Chum (Tlupana)	10,000	925	1,656	0.8
Robertson Creek Hatchery				
Not available at time of printing.				

*Includes facilities constructed prior to SEP.

Table 18

West Coast Vancouver Island SEP Facilities*: Adult Production

Species	Expected Production from 1983 Releases: Total Adult Production	Years of Return	Contribution to Fisheries	At Full Production: Total Adult Production	Contribution to Fisheries
San Juan Enhancement Society Project					
Chinook	3,240	1985-1989	2,592	7,560	6,048
Coho	16,268	1985-1987	8,947	N/A	N/A
Chum	16	1985-1987	7	16	7
Sockeye	424	1985-1986	237	424	237
Nitinat River Hatchery					
Chinook	72,000	1984-1987	57,600	75,000	60,000
Chum	168,640	1985-1987	126,480	540,000	405,000
Coho	4,410	1984-1985	3,528	7,000	5,250
Thornton Creek Hatchery					
Chum (unfed)	2,716	1985-1987	1,195	N/A	N/A
Chum (control)	1,351	1985-1987	594	N/A	N/A
Chum (sterilized)	967	N/A	425	N/A	N/A
Coho (fry rel.)	1,244	1986-1987	684	N/A	N/A
Coho (smolt rel.)	4,505	1985-1986	2,478	N/A	N/A
Chinook (Robertson Cr. transplant)	1,031	1985-1989	825	N/A	N/A
Chinook (L. Kennedy stock)	266	1985-1989	213	N/A	N/A

Robertson Creek Hatchery
Not available at time of printing.

Tlupana Inlet/Conuma Hatchery
Not available at time of printing.

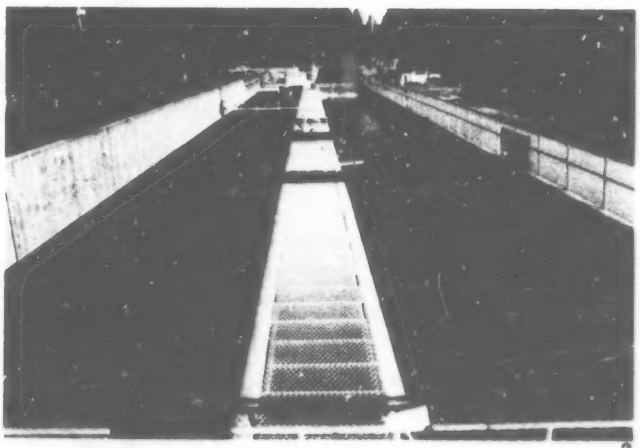
*Includes facilities constructed prior to SEP.
N/A means "not available."

East Coast Vancouver Island

1. Helicopters are used to transplant coho at Comox Lake.
2. Dip netting on the Cowichan River.
3. Chinook brood stock fill the holding ponds at Big Qualicum hatchery.

1

2



3

East Coast Vancouver Island

Cowichan Band Project

This project is located on the lower reaches of the Cowichan River, near Duncan. The Band enhances stocks in the Cowichan River system, namely chinook, coho and chum salmon. The project provides employment for five full-time people and some seasonal work as well.

In 1983, the project continued its regular incubation and rearing activities and its hatchery tours. A number of improvements were also made to the facility. These included completion of a roof over the Capilano troughs, improvements to the intake of the back-up water supply and installation of an alarm system. The Band also carried out fry salvage in the Cowichan and Koksilah system, salvaging approximately 50,000 coho.

Plans for work in 1984 include increasing the chinook egg target to 500,000 and transplanting 100,000 Cowichan chinook to the Koksilah River system.

Contact: Barry Cordocedo, Project Coordinator, Special Projects Division.

Vancouver Island Hatchery and Offsite Rearing

Vancouver Island hatchery is a newer facility operated by the Fish and Wildlife Branch, provincial Ministry of Environment, producing both steelhead and anadromous cutthroat. Entirely funded by the Salmonid Enhancement Program, the hatchery was built in 1982 as an adult holding, egg incubation and fry rearing facility to supply both anadromous fry and smolts for several streams throughout Vancouver Island. Fry are reared at Vancouver Island hatchery, and all smolt production is carried out at three offsite net-pen rearing locations. The first full year of production for this hatchery was 1983, although smolt production has been ongoing at the offsite rearing locations since 1979.

Hatchery construction was carried out in 1982 with some minor revisions completed during 1983. The facility consists of:

- a well supplying a water flow of approximately 4,500 litres per minute from three pumps
- an adult brood stock holding area consisting of fourteen isolation boxes each having eight covered compartments for isolating adult fish (These boxes allow for easy access to fish as well as an environment where the possibility of disease transfer between fish is kept to a minimum.) and six wooden group holding tanks, each of 5,000 litre capacity and lined with smooth plastic swimming pool liners for the purpose of holding larger groups of steelhead or cutthroat adults for extended periods
- a 40 x 10 metre prefabricated Quonset hut style portable fabric building with twenty-four 3,000 litre flat-bottomed aluminum troughs. These troughs are used for both egg incubation and fry rearing.

In 1983, adult cutthroat were collected by four methods: angling, trapping, seining and electroshocking, depending on the stream conditions. Adult steelhead were collected primarily by angling although seining was used in a couple of instances. Oyster River cutthroat and steelhead were held and spawned at Black Creek ponds and the eggs shipped to Vancouver Island hatchery for incubation, while the Sandhill captive brood stock were held at North Saanich ponds and the eggs also shipped to the hatchery. All

other adults were held and spawned at Vancouver Island hatchery.

A program of routinely injecting incoming adult fish with antibiotics was carried out during 1983 to assist in preventing adult holding losses due to furunculosis. This proved quite successful and will be continued.

Eggs were incubated in wire baskets in troughs where the resulting fry were reared until release time. Fry were outplanted to twelve stream systems on Vancouver Island, and the presmolts were transferred to the offsite locations until smolting time. At release time, fry were either scatter-planted by hand or point-released from a new helicopter release mechanism designed and built in 1983. This device proved very successful in terms of load carried, versatility and worker safety.

Tsitika River steelhead fry were also reared at Vancouver Island hatchery until early summer and transferred to net pens in O'Connor Lake near Port McNeill for summer steelhead smolt production. These smolts were once again to be released into Campbell River as part of the program to introduce a summer-run steelhead fishery to that river.

A total of 43,000 Englishman River steelhead eyed eggs were shipped from Vancouver Island hatchery to Big Qualicum hatchery for smolt production at that facility.

All anadromous cutthroat and steelhead smolt production was carried out at three separate net-pen rearing locations. Some fry reared at Vancouver Island hatchery were transferred to these locations in late summer where fish were fed by automatic feeders until smolting the following spring. They were then outplanted from these net pens to their respective streams.

In 1983, 45,701 steelhead smolts were released into the lower Cowichan River from the Cowichan net pens. All fish were fin-clipped and nose-tagged. A total of 29,157 fin-clipped anadromous cutthroat smolts were also reared and released into four streams from two separate offsite rearing locations.

Growth was generally good at all offsite locations. In the previous two years, juvenile mortalities were high at the Cowichan net pens but this problem has been rectified by holding the fry on cooler well water until the lake water temperatures have decreased in the fall.

Contact: Ray Billings,
Hatchery Supervisor,
Vancouver Island Hatchery,
Duncan.

Chemainus River Hatchery

During 1979, a contract was initiated with Apex Bio-Resources to enhance the remnant stock of chinook salmon (about 50 adults) in the Chemainus River. Using a mixture of purebred Chemainus stock and a complement of Chemainus males and Cowichan females, the stock was sufficiently increased by 1982 to allow all of the brood stock to come from the Chemainus River.

During 1982, Apex Bio-Resources was replaced by Sea Spring Salmon Farms, and coho enhancement was added to the contract. The chinook work remained as a full-time rearing program, but the coho was established as a fed fry (5 g by late June) program, with those fry being released in the upper watershed.

The 1982 egg-take produced a release in 1983 of 193,508 chinook smolts and 73,421 fed coho fry. The targets for 1983 egg-takes were the same as in 1982 (200,000 chinook and 75,000 coho eggs) and were readily attained.

The Chemainus chinook stock appears to have responded well to enhancement efforts (escapement levels now are 79 adult chinook), and for two years now the production targets have been readily achieved. It is expected that this will continue to be the case.

Contact: Dave Barrett,
Head,
South Coast Unit,
Enhancement Operations.

Nanaimo Community Development Project

This project, located near the mouth of the Nanaimo River, is responsible for the enhancement of Nanaimo River stocks. These include spring and fall chinook, coho and chum salmon. It provides full-time employment to six people, plus some seasonal work.

The steelhead program at this location was cancelled in 1983. However, a new chinook program was initiated. The project, working with the Pacific Biological Station at Nanaimo, will be holding 1,200 upper Nanaimo spring chinook fry until they reach adulthood. These fish will be used as brood stock for a chinook stock which is now almost extinct.

Work planned for 1984 includes the installation of a new pump which will deliver an additional 4,100 L/minute of water. Federal job creation program funding will provide for the construction of two extra raceways and for stream improvements on Napoleon Creek. The hatchery will also continue its normal operations with chinook, coho and chum.

Contact: Barry Cordocedo, Project Coordinator, Special Projects Division.

Little Qualicum Project

This facility is located on the Little Qualicum River, 2 km north of Qualicum Beach. It includes an artificial spawning channel for chum salmon and a rearing channel for juvenile chinook and steelhead trout.

The spawning channel, measuring 4.2 km long and 7.5 m wide, will accommodate 50,000 spawners and produce an estimated 59 million fry annually. It was hoped that the channel would be at full production by 1984; however, escapements to the system have been below normal since the project began in 1979. It appears that it may take an additional four years to reach this goal.

The rearing channel has a capacity for 1.5 million chinook smolts and 40,000 steelhead smolts. All fish for the rearing program are being supplied by the Big Qualicum hatchery. Therefore, it has been possible to operate at full production since opening in 1980. In 1983, a good return of adult chinook was experienced, with an estimated 2,000 spawning in the river upstream of the diversion fence, as well as 1,266 adults and 618 jacks counted in the spawning channel.

This project has the capacity to contribute over 150,000 chum, 30,000 chinook, and 1,000 steelhead to the sport, commercial, and Indian food fisheries annually.

Special activities carried out during the year were again aimed at increasing chum production. The expanded chum fry rearing program released 2.7 million fed fry.

The helicopter airlift of adult chum was carried out again this year. Since a larger number of chum adults entered the channel of their own accord, it was only necessary to airlift 4,400 adults from the river mouth to the channel.

Over 300 female and 224 male chinook were held for brood stock in 1983; their eggs were transported to the Big Qualicum hatchery for incubation.

Contact: Grant Ladouceur, Stock Enhancement Officer, Enhancement Operations.

Big Qualicum Project

The Big Qualicum project is located approximately 60 km north of Nanaimo on the Island Highway. It was developed to increase the production of native stocks of chum, coho, and chinook salmon, as well as steelhead trout, through environmental control. The first stage of the project, completed in 1963, included the construction of facilities to allow year-round regulation of river discharge and to provide a degree of water temperature control during the summer and fall. The second phase was carried out from 1964 to 1967

and involved the construction of two artificial spawning channels. The latest stage in development is the hatchery program, which began in 1968.

Flow control has more than doubled egg-to-fry survival for all species. Chum, however, have received the most benefit from this situation because their production is not limited by the available rearing area in the river.

The first spawning channel was originally built to accommodate pink salmon and was later used as a chum and chinook spawning channel. Design problems resulted in poor egg-to-fry survivals; therefore, the channel was modified and is now used to rear hatchery chinook and coho. The second spawning channel, designed specifically for chum salmon, has been extremely successful. This channel will accommodate 25,000 spawners producing up to 27,000,000 fry annually, for an egg-to-fry survival of approximately 75 percent.

The hatchery program at Big Qualicum began as an experimental installation, testing various facilities and techniques for future hatchery development plans for other locations. After 1971, the hatchery became more production oriented. Since that time, it has expanded to become one of the largest production facilities in B.C. The present incubation capacity is 20 million eggs and the rearing capacity is: 1 million coho smolts, 3 million chinook smolts, and 75,000 steelhead smolts. Over 5 million coho and chinook eggs are sold each year to privately-owned fish farms. Some are used for research, and others go to public involvement projects. Also, two million chinook and 500,000 coho fry are used for recolonization of seven local streams. Steelhead smolts are produced for release into Big Qualicum as well as a number of other east coast Vancouver Island streams, including Little Qualicum, Englishman, Chase, and Millstone.

The Big Qualicum project is currently operating at capacity, contributing approximately 150,000 chum, 100,000 coho, and 90,000 chinook to the sport and commercial fisheries as well as over 70,000 fish (most of which are coho) to the Indian food fishery annually. The value of this annual catch has been estimated to be over $8.5 million.

In addition to normal production, 3.5 million coho eggs were collected at Big Qualicum in the fall. It is hoped that the extra fish production will enhance sport fishing in local waters during the summer of 1986 when several million visitors are expected to visit the Vancouver area to attend Expo 86 Construction is presently underway on two new channels which will provide the rearing capacity required. Most of these fish will be released as smolts in spring 1985, while others may be reared in sea pens and released to various locations in the Strait of Georgia.

During 1983, a bulk incubation system for chum was tested. A Bams-type incubation box, with the gravel substrate removed, was loaded with over 2.7 million chum eggs. Survival was excellent at 95.1 percent to the eyed stage.

Contact: Grant Ladouceur,
Stock Enhancement Officer,
Enhancement Operations.

Puntledge River Hatchery

The Puntledge River hatchery is located 2 km from Courtenay on Vancouver Island. The main hatchery site has been operational since 1979; full production target date is 1989. The hatchery complex consists of three sites; the upper site, lower or main site and Tsolum project.

The upper site is located 9 km upstream from the main site. It facilitates the capture of adult summer chinook and summer steelhead and the rearing of summer chinook, coho and summer steelhead.

The lower site accommodates all incubation, the capture of fall chi-

nook, coho, pinks and chum and the rearing of fall chinook, pinks, chum and winter steelhead.

The Tsolum River project is a satellite of the Puntledge hatchery and is operated fully from the main site. The project facilitates the trapping and holding of adults and the rearing of Tsolum River pink salmon.

Summer Chinook

A time and size at release study was done on the 1982 brood summer chinook to see if the smolt-to-adult survival can be increased.

Coho

In fall 1983, the adults returned from the first Comox Lake colonization program. In total, 3 percent of the release of the 1980 brood entered the hatchery, showing that the colonization program can succeed in having smolts migrate past the B.C. Hydro dams, penstock and turbine. With the colonization program, the total Puntledge River production can be increased by 25 percent. This enables all potential rearing areas of Comox Lake and its tributaries to be utilized.

Tsolum Project

No major modification or construction was done at the hatchery during 1983. At the Tsolum project, however, a new bridge was installed crossing the Headquarters Creek, replacing a steel arch culvert.

Contact: Harry Genoe, Stock Enhancement Officer, Enhancement Operations; Jim Wild, Senior Project Engineer, Engineering.

Quinsam River Hatchery

The Quinsam River hatchery is located less than 5 km west of downtown Campbell River. In operation since 1974, it is currently at full production for the available rearing space. During 1983, the pink salmon offsite rearing program was carried out in the Campbell River estuary and plans are to continue this in 1984.

Chinook returns to the Campbell and Quinsam Rivers in 1983 totalled 2,556 fish. Of these, 1,246 chinook averaging 10-12 kg spawned naturally in the Quinsam River. Another 550 were used in the hatchery for brood stock. In 1983, 22,895 coho adults returned to the Quinsam River.

Special Studies

a) Coho colonization

Natural coho spawning and an outplant of 248,000 fed fry in the fall of 1982, produced a migration of 110,000 smolts during the spring of 1983.

In the fall of 1983, 244,600 reared fry (average size 10.5 g) were transported and released in the upper Quinsam River. A helicopter was used for the fourth year in a row to transport the fish, which were stocked at a density of 14-15,000 per kilometer.

b) Diet studies

Since 1975, an ongoing evaluation of dry fish feed has been carried out, and since 1976 a diet formulated by the research group at West Vancouver has been tested with coho.

c) Coho density

A program for evaluating the effects of rearing density has been continued by Fisheries Research Branch using stock of the 1982 coho brood in groups of 50,000, 70,000, and 90,000. These groups have been marked and will be released in May, 1984.

d) Surface water versus groundwater smolting

One Burrows pond has been converted for use with surface water, to allow comparison between coho reared to smolt stage in surface water and those reared in groundwater. The coho smolts have been marked to determine relative survivals to adult stage.

e) Clarifiers as an alternate rearing facility for coho smolts

The coho production target was increased by 250,000 by utilizing the clarifiers as rearing containers. This was done to confirm the practicality of reusing clarified water.

f) Chinook time and size at release

Chinook smolts were marked according to size (small, medium, and large) and released at four time intervals in spring 1983 to determine the best time and optimum size for release of chinook from Quinsam hatchery. This is the final year of size and time studies. Collection and assessment of data will continue throughout 1984. This information is expected to contribute to increased chinook survival, benefitting the sport and commercial fisheries.

g) Pink enhancement

Seven and a half million pink salmon eggs were incubated in Heath trays. The resulting alevins were surface planted into gravel boxes. Upon emergence in 1984, approximately 600,000 will be transported to the estuary and reared in aluminum pens. The balance will be released directly into the Quinsam River.

h) Quinsam River watershed

Job creation funds were used to gather baseline data of the watershed in advance of coal mine development. Additional information was gathered on utilization of this area by outplanted coho.

Maintenance

Several repairs were carried out at Quinsam hatchery this year, including replacement of the Cold Creek intake screens, rewiring of the parking lot lights to meet safety standards, installation of screens in the pipes in the aeration tower, and diversion of roof drain water and marking room water to the storm drain system.

Construction

A 167 m^2 storage shed was constructed, and a large concrete pad was built and plumbing installed to facilitate operation of 32 Capilano-style rearing troughs. Associated sidewalks, fences, and curbs were installed and landscaping was done.

Contact: Jim Van Tine, Stock Enhancement Officer, Enhancement Operations.

Bear River Hatchery

The Bear River (Amor de Cosmos Creek) hatchery is located northeast of Campbell River on the Bear River, which exits from McCreight (Bear) Lake, and flows into Johnstone Strait on the east coast of Vancouver Island.

In 1980 this facility, originally an experimental project, was turned over to SEP for production operation. The Bear River project was operated during 1980, the on-cycle year, for pink salmon. Due to extreme fishing pressure, the pink adult returns in 1982 were insufficient for brood stock.

In spring 1982, 1.8 million pink salmon fry were transported from the Quinsam River hatchery and released into the Bear River. Adult assessment indicated that the 1983 escapement totalled 1,200 pink, returning to spawn from the Quinsam stock transplant on the off-year cycle of Bear River. This return, though encouraging, was still insufficient to provide the stock required to operate the hatchery. If 1984 pink salmon returns are low, alternate species will be considered.

Routine maintenance was carried out through 1983, and the remainder of the old counting fence was removed.

Contact: Jim Van Tine, Stock Enhancement Officer, Enhancement Operations.

Nimpkish Hatchery

The Nimpkish project expanded to include two facilities in 1983-84. The main facility is the Willow Creek hatchery, located at the southwest end of Nimpkish Lake. This facility is designed to produce up to 3.5 million sockeye fry, 150,000 chinook fry and 150,000 coho fry annually. A second pilot facility has been constructed over the past year to produce up to 1.5 million chum fry at the Cheslakee campground on the lower Nimpkish River near the outlet to Broughton Strait. All these stocks will contribute to the native, commercial and sport fisheries in the Broughton Strait area.

In 1983, the Nimpkish Indian Band contracted to produce 3.0 million sockeye fry, 50,000 chinook fry, 50,000 coho fry and 750,000 chum fry from the two facilities. A total of 2.4 million sockeye, 403,000 chum and 76,000 chinook were released from the two facilities. Chum salmon brood stock were helicopter transported from saltwater pens to freshwater pens in Nimpkish Lake for the first time this past year with a resultant increase in fertilization success and decreased brood stock mortality. Future expansion plans for the Cheslakee chum facility would include brood stock holding facilities at this site.

Every effort will be made in the 1984/85 contract year to increase the chinook and coho production to 100,000 for each of these species. Plans include the production of up to 3.2 million sockeye fry at the Willow Creek site and 1.4 million chum fry at the Cheslakee site. Warmer, silt-free groundwater at the Cheslakee site has led to high chum fry survival rates and earlier fry emergence that coincides with natural downstream migration timing.

This project provides employment for four full-time employees and up to four additional seasonal workers during brood stock collection times. Two job creation programs employed 3 people for 40 weeks during the construction and operation of the Cheslakee facility.

Contacts: George Bates, Community Advisor, Special Projects Division.

Northern Vancouver Island Salmon Enhancement Association (NVISEA)

The Northern Vancouver Island Salmon Enhancement Association (NVISEA) is registered as a nonprofit society in British Columbia. The Association's main objective is enhancement of the salmonid stocks on Northern Vancouver Island.

The Association was formed in December 1982 and the first on-site work was done in March 1983. By October 1983, the Association had built two hatcheries. The Quatse hatchery located just off the Coal Harbour Road, and the Stephens Creek hatchery located in Stephens Creek on the outskirts of Coal Harbour, have a combined capacity to incubate and rear up to 6 million fry annually. The hatcheries are set up as satellite facilities: brood stock and eggs will be brought in, incubated and reared and then released back into their stream of origin.

The five groups of coho are to be reared and released in two lots. Some will be released as 2-to 3-gram fry in the spring and the remainder as 5- to 7-gram fry in the fall. The hatchery staff plans to nosetag approximately 125,000 of the coho fry in the spring of 1984.

The community as a whole has been very supportive of the project. The forest companies, the local fish cannery, town councils and local business made some very generous donations to the Association.

Contact: George Bates, Community Advisor, Special Projects Division.

Provincial Status Report

Steelhead Stock Assessment

A major objective of SEP since its inception has been to improve the data base for steelhead stocks throughout the province. On Vancouver Island, a partial list of methods employed in this exercise includes analysis of com-

mercial fishery catch data, creel and questionnaire surveys, snorkel surveys, electrofishing surveys, habitat capability analysis, smolt abundance monitoring, and coded-wire tag analysis. Evidence of overexploitation of steelhead, most commonly by sport fishing, was sufficient to warrant the imposition of heavy restrictions on wild steelhead harvest in the late 1970s. In 1983, the evaluation of management by regulation continued.

A steelhead smolt production model developed by research staff of Fish and Wildlife provided the mechanism for estimating theoretical smolt and adult production in all major streams on Vancouver Island. The focus recently has been to relate steelhead catch data to production and compare actual to theoretical production to aid in evaluating restrictive harvest regulations.

Initial interpretations indicated that wild steelhead stocks in streams whose habitat was relatively stable responded quickly to increased escapements. Catches rose sharply four and five years after implementation of kill reductions. However, in streams seriously impacted by forest harvesting, the responses were not significant. In yet another category of streams, it appeared that the incidental harvest of steelhead by gillnets has served to keep steelhead production well below its estimated potential.

Management activities for specific waters have been identified. In most situations, these have been or will be incorporated into the production program. The immediate future of the stock assessment program should include fine tuning of the production model, especially as it relates to larger streams and assessing the impact of steelhead caught in river gillnet fisheries.

Contact: Bob Hooton,
Fisheries Biologist,
Fish and Wildlife Branch,
Nanaimo.

Steelhead Production

Steelhead production is one of the two major SEP-funded steelhead projects on Vancouver Island. The program includes both hatchery and wild steelhead components.

In 1983, five federal, two provincial, and one community development facility were involved in the culture of 18 steelhead stocks from 16 watersheds. Green egg production for the 1983 brood totalled 1.6 million, from which 656,000 fry and 440,000 smolts were liberated. Approximately half of the fry originated from incubation experiments conducted at Robertson Creek and Big Qualicum hatcheries. These fry were liberated in landlocked lakes and will not contribute to adult steelhead production. The expected returns from the remaining fry and smolt liberations total 1,600 and 13,000, respectively.

The hatchery steelhead program has been well received by the majority of anglers. Fishing effort on four major streams in which hatchery fish are now available grew from 20 percent of the regional total in the pre-hatchery period to almost 50 percent in 1983. Hatchery fish comprised 58 percent of the estimated 3,255 steelhead caught and retained on Vancouver Island in 1983 and 23 percent of the total catch (hatchery plus wild) of 29,569.

The wild steelhead production program on Vancouver Island has focused on management by regulation. Evaluation of the regulations imposed in 1979 to reduce wild steelhead harvest and increase escapement continued in 1983. On many streams, harvest restrictions have had a dramatic impact. Catches in 1983 were the highest recorded as the returns from increased escapements materialized. The total regional catch of wild steelhead was also the highest ever recorded.

Streams and stocks which appear not to have responded to the restrictive harvest approach were categorized as those which suffer serious impairment of habitat and smolt carrying capacity and/or those which are subject to harvesting by gillnets.

Contact: Bob Hooton,
Fisheries Biologist,
Fish and Wildlife Branch,
Nanaimo.

Vancouver Island Sea-Run Cutthroat Trout

a) Stock Assessment

In 1983, the assessment of the hatchery and smolt program on Colquitz Creek was completed. The objectives of the four-year program were to determine:

- the impact of the hatchery smolt program on the sport fishery in the Gorge waterway
- the rate of contribution of hatchery and wild smolt stocks to the fishery
- the survival of hatchery and wild cutthroat from saltwater entry to spawning in Colquitz Creek.

A permanent trap was located on Colquitz Creek to enumerate cutthroat spawners as well as the downstream movements of hatchery and wild cutthroat smolts and adults. The creel survey on the Gorge waterway provided data concerning angler effort and catch for cutthroat trout in the sport fishery.

Hatchery cutthroat smolts were released at an average size of 70 g in early April, approximately 4 km above the fence. The movement of smolts to salt water was influenced by small freshets and rising water temperatures (7°C to 11°C). Peak migrations occurred within two weeks after release. Survival of hatchery smolts, from release to saltwater entry, averaged 70 percent during the study, with only a minor component (5 percent) staying as residents in the stream.

A comparison of effort and catch during the 1980, 1981 and 1982 creel surveys revealed that the stocking of hatchery smolts significantly influenced the fishery. In 1981, a two-fold increase in the number of smolts released (20,000) led to a doubling of effort (to 3,800 angler days) and catch per hour (to .38). Hatchery cutthroat in their first summer of saltwater migration accounted for up to 95 percent of the catch in the fishery. The smolt size that contributed the highest adult returns to the fishery was 80 grams. The average rate of return of hatchery smolts from release to the fishery was 7.0 percent (range 13.4 percent to 0.46 percent).

Hatchery fish returning to Colquitz Creek to spawn after one summer of saltwater residence represented 70 percent of the annual escapement. The mean hatchery smolt survival from stocking to spawning escapement represented 0.8 percent of the release. The results of this program emphasize the need for managers to wisely select the cutthroat fisheries that should receive smolt stocking, with wild fish providing the backbone to natural recruitment.

A creel survey of the Oyster River estuary during August and September 1983 was initiated to provide a comparison of hatchery smolt stocking with the Gorge program. The survey estimated 1,200 angler days and 1,667 cutthroat caught, of which 78 percent were hatchery origin and 22 percent wild. Hatchery smolts in their first, second and third summer in salt water contributed 62 percent, 31 percent and 7 percent respectively to the hatchery cutthroat catch. In 1984, an expanded creel survey on the Oyster will provide catch and effort data that will be used to formulate the management guidelines for hatchery smolt stocking in Island rivers.

The protection of wild cutthroat stocks through angling regulations has begun to show encouraging results. Snorkel surveys begun on the Oyster River in 1979 recorded 5.6 wild cutthroat adults per kilometre, migrating upstream during the peak of the spawning run. In 1983, the wild stock is estimated to have increased to 14 wild fish per kilometre. This survey program has shown similar results in most Vancouver Island cutthroat trout populations.

Wild stock management in 1983 concentrated on the preservation of juvenile rearing habitat in small streams.

The problem of poor trout survival, brought about by competition with enhanced coho was brought to the attention of federal salmon managers. The adoption of tighter controls in the selection of fry release sites will allow cutthroat juvenile populations to naturally rebuild. Participation in the federal Salmonid Habitat Inventory Program (SHIP) in 1983 and the Low Flow Study on the east coast of the Island, will provide measurement of available habitat, necessary for estimating the theoretical smolt and adult production of coho and cutthroat in Vancouver Island streams.

b) Production

In 1983, 35,000 cutthroat trout smolts were released into six streams on the east coast of Vancouver Island. Cutthroat fry production was 52,000 fish, released into ten candidate nursery streams. The majority of cutthroat trout fish culture was completed by provincial fish culture staff at the Vancouver Island hatchery in Duncan. Interest in cutthroat trout culture at two federal hatcheries (Puntledge River and Big Qualicum River) allowed for experimental production in 1983, with a potentially larger role in cutthroat enhancement in 1984 and beyond. Two small federal projects (Nanaimo Community Development Project and Courtenay Rod and Gun Club) also provided assistance in cutthroat brood stock acquisition and fish culture in 1983.

Contact: Peter Law,
Fisheries Biologist,
Fish and Wildlife Branch,
Nanaimo.

Job Creation Projects

Inventory of Victoria Tidal Foreshore

The goal of this project was to take a biophysical inventory of the tidal foreshore in the Victoria area. Six workers inspected the shoreline, logging locations, and structures such as launching ramps, finger floats, marinas and sewage outfalls.

They interviewed crab fishermen to determine the sex composition and sizes of their catches and also their total catch per fishing trip.

One worker analyzed shellfish products for sewage contamination and paralytic shellfish poisoning.

Cowichan Indian Band Project

The nine-person crew on this project were involved in a number of activities. They included:

- installing and monitoring a V-trap on the Cowichan River
- mapping in detail all side channels and tributaries in the Cowichan-Koksilah system
- rehabilitating streams and salvaging coho fry
- constructing a shed to protect the Band's hatchery rearing troughs.

Halalt Indian Band

Seven members of the Band helped DFO staff with hydraulic sampling and the monitoring of downstream fry migration in the Westholme Channel near Chemainus. They also placed riprap along the channel to stabilize the banks and they removed debris.

Impact of Lake Enrichment on Total Productivity

This project examined the impact that lake enrichment for sockeye production has on freshwater bivalves. The eight employees collected bivalves from a number of lakes undergoing nutrient enrichment; the samples were examined at the Pacific Biological Station in Nanaimo. Sockeye presmolts and water samples were also collected for laboratory analysis.

Historical Salmonid Biology Data

The 31 workers in this project consolidated historical fisheries data at the Pacific Biological Station. They also assisted staff in genetic and population studies, including fieldwork.

This consolidation of data will provide fisheries managers quick access to information needed for arriving at management decisions. It will also be beneficial to continuing research studies.

Quinsam River Coho Habitat

The Rotary Club of Campbell River sponsored this project to evaluate the areas of the upper Quinsam River which are utilized by coho. Under the supervision of Quinsam River hatchery staff, the nine project employees also did maintenance work at the hatchery site, removed an old counting fence at Bear River hatchery, and built a nature trail along the Campbell River.

Campbell River Estuary and Watershed Society

The Society sponsored a project out of the Quinsam River hatchery near Campbell River. Among the activities carried out by the 16-person crew were:

- regular sampling of water levels, temperatures, and water quality in Quinsam River
- biological and physical stream surveys of Bear River and Page Creek to assess potential for coho colonization
- closing in sides of the Quinsam hatchery carport
- minor repairs to trail and hatchery compound.

Willow Creek Conservation

Willow Creek flows into Georgia Strait near Campbell River. This project had five workers building trails along the creek, clearing parking spaces, and erecting information signs. They installed picnic tables, established camping sites, and marked areas for viewing spawning salmon. As well, they conducted a biophysical survey and did some habitat restoration.

Campbell River Development Plans

Five people were hired to study industrial and municipal development plans and how the plans might affect salmonid enhancement in the Campbell River/Quinsam River area. They outlined planning considerations which would allow for further urban and industrial growth in a manner which would best protect fish habitat in the area.

Rotary Club of Campbell River

Nineteen people under the sponsorship of the Rotary Club of Campbell River worked out of the Quinsam River hatchery on a number of tasks. They included:

- cleaning up the hatchery site by pruning evergreens, removing alder and underbrush, and general landscaping
- extension and maintenance of the hatchery trail, including replacement of two bridges
- removal of car bodies and other debris from the Quinsam River
- assessing coho escapement to 15 small streams in the area.

Quadra Island Salmon Enhancement

The Quadra Island Salmon Enhancement Society sponsored this project to assist them in developing a hatchery. Five employees dug a pit for collecting hatchery waste water, prepared a concrete holding tank in the hatchery, and installed plumbing lines and valves for two rearing tanks.

The workers also dug a spawning channel for chum salmon in Drew Creek and cleared debris from Granite Bay Creek.

Keogh River Steelhead

Fourteen project workers counted wild and hatchery steelhead smolts as well as coho, dolly varden char, and cutthroat trout passing the Keogh River fence. They clipped fins, sorted, counted, and transplanted steelhead from the O'Connor Lake net pens. Other activities included:

- construction and placement of experimental troughs and their maintenance as part of the Keogh River fertilization program
- placement of gravel in appropriate spawning areas.

Stephens Creek, Quatse River Project

The Northern Vancouver Island Salmon Enhancement Association sponsored a project for four people to help in carpentry and landscaping jobs at two hatcheries; Stephens Creek and Quatse River.

Read Island Salmonid Enhancement

Five project workers helped develop the Read Island enhancement site at Heriot Bay. They constructed an incubation box, cleared the site and improved road access, monitored water

temperatures and quality, and surveyed area streams.

Gilford Island Coho Hatchery

The purpose of this project was to trap coho fry and conduct a bioreconnaissance survey of the six streams from which coho brood stock will be collected for the hatchery in Scott Cove. In addition to these activities, the 13 workers cleared debris from the streams, cut trails, and helped in construction jobs at the hatchery site.

Contact: Colin Masson, Project Coordinator, Special Projects Division.

Table 19

Public Participation Projects

EAST COAST VANCOUVER ISLAND PUBLIC PARTICIPATION PROJECTS

Location	Name of Group	No. of People Involved in 1983	No. of Years Group Involved In SEP	Type of Project	Species	Juveniles Released	% Survival	Expected Adult Production from 1983 Releases
Goldstream River	Amalgamated Conservation Society	100	7	incubation, stream improvement, feeding	coho	117,00	96	2,300
					chinook	2,500	63	495
Goldstream River	Discovery Elementary School	33	3	incubation in school	chum	17,000	69	134
Goldstream River	Shawnigan Lake Boys School	60	4	incubation	coho	5,000	55	60
					chum	28,300	93	226
Shawnigan Creek	Mill Bay & District Conservation Society	12	5	incubation	coho	19,800	42	238

Coonskin Creek/ Bear Lake	Yount Elementary School	30	4	incubation	coho	50,000	95	600
Sooke River/ Rocky Creek	Sooke Conservation Society	36	7	incubation, feeding	coho chinook	465,500 39,000	92 98	7,918 585

Contact: Trevor Morris, SEP Community Advisor

Millstone River System	Nanaimo Fish & Game Protection Assn.	120	4	fishways, stocking	coho	50,000 Transplant from Nanaimo River.	—	600
French Creek	Parksville-Qualicum Rod & Gun Association	25	3	incubation	coho	1,000	3	12
Beach Creek	Parksville Secondary School	30	4	incubation, feeding	coho	10,000	71	360
#1 Supply Creek/ Trent River	Courtney District Fish & Wildlife Protective Assoc.	10	6	incubation	coho	180,000	95	2,200
Roy Creek	Cumberland Chamber of Commerce	5	3	incubation	coho	20,000	91	240
Kitty Coleman Creek	Pacific Trollers Assoc.	18	7	incubation, feeding	coho	14,000	44	444
Drew Harbor Creek	April Point Flyfishing Club	10	5	incubation, fishways, construction	chum	68,000	85	544
Hyacinthe Creek	Quadra Island Salmonid Enhancement Society	20	4	incubation, studies, stream improvement, information, construction	coho chum	199,000 49,000	90 90	2,400 392
Granite Bay Creek	Granite Bay Conservation Society	—	4	incubation	pink	Incubation box flooded and completely silted.		

Contact: Bryan Allen, SEP Community Advisor.

EAST COAST VANCOUVER ISLAND PUBLIC PARTICIPATION PROJECTS

Location	Name of Group	No. of People Involved in 1983	No. of Years Group Involved In SEP	Type of Project	Species	Juveniles Released	% Survival	Expected Adult Production from 1983 Releases
Charles Creek	Alert Bay Fishermen's Society	—	1	incubation	chum	Planted 500,000 eggs from Viner Creek.		

Contact: George Bates, SEP Community Advisor.

Table 20

East Coast Vancouver Island SEP Facilities*: Juvenile Releases 1983

Species	Brood	Group	Total Released	% Marked	% Survival	Average Size(g)
Quinsam River Hatchery						
Coho	1981	Quinsam	1,018,596	27	N/A	23.6
Chinook	1982	Quinsam	1,094,199	52	N/A	5.0
Pink	1982	Quinsam	2,871,272	7	N/A	.40
Steelhead	1982	Quinsam	21,887	0	N/A	47.7
Steelhead	1983	Quinsam	40,000	0	N/A	5.0
Cowichan Band Project						
Chinook	1982	Cowichan	224,000	22	93	4.0
Chum	1982	Cowichan	700,000	0	70	1.5
Coho	1982	Cowichan	16,495	0	14	3.0
Nanaimo Community Development Project						
Chinook	1982	upper spring run	2,634	100	97	1.2
Chinook	1982	lower spring run	14,994	100	46	1.2
Chinook	1982	fall run	139,084	17	93	5.5
Coho	1982	Nanaimo	368,963	12	96	4.9
Chum	1982	Nanaimo	724,000	0	74	0.7
Steelhead	1982	Nanaimo	89,800	0	76	1.7
Chemainus River Hatchery						
Chinook	1982	Chemainus	100,806	34	N/A	5.8
Chinook	1982	Chemainus	92,702	41	N/A	6.9
Coho	1982	Chemainus	73,421	0	N/A	4.6
Little Qualicum Project						
Chinook	1982	Big Qualicum	1,201,723	6	N/A	7.5
Chum	1982	Little Q.	22,848,250	0.8	N/A	.37
Chum	1982	Little Q.	2,719,557	35	N/A	.73
Steelhead	1982	Little Q.	2,493	100	N/A	52.7
Steelhead	1982	Cameron Lake	3,720	100	N/A	10.0
Steelhead	1982	Little Q.	10,000	100	N/A	52.7

*Includes facilities constructed prior to SEP.
N/A means "not available."

Table 20 (Cont'd)

Species	Brood	Group	Total Released	% Marked	% Survival	Average Size(g)
Big Qualicum Project						
Coho	1981	production	1,159,263	4.54	67	20.95
Coho	1981	colonization	10,000	4.54	94	14.9
Coho	1982	colonization	619,070	0	96	unfed fry
Coho	1982	colonization	10,595	0	92	6.22
Chum	1982	production	2,600,000	3.57	83.8	1.0
Chum	1982	wild	53,600,000	0.37	29.1	0.33
Chinook	1982	production	2,783,940	2.85	81.85	7.97
Chinook	1982	L. Qualicum	1,539,731	N/A	N/A	0.49
Chinook	1982	diet study	15,434	0	89.0	5.7
Cutthroat	1982	Nile Ck.	3,449	100.0	74.6	27.5
Cutthroat	1982	Nile Ck.	2,433	100.0	74.6	83.1
Steelhead	1982	colonization	35,564	0	76.2	5.6-70.0
Steelhead	1982	Englishman R.	30,546	97.8	37.0	5.6-63.1
Steelhead	1983	Englishman R.	8,848	87.0	87.0	6.0
Steelhead	1982	wild to B.Q.	24,531	97.6	65.8	40.6-80.9
Steelhead	1983	wild to L.Q.	38,000	0	85.2	11.0
Steelhead	1983	colonization	50,643	0	71.0	0.80-11.0
Puntledge River Hatchery						
Coho	1981	production	933,015	6.5	70.0	19.0
Coho	1982	colonization	3,228,016	3.3	95.0	3.3
Chinook	1982	summer run	1,344,669	6.1	88.6	9.6
Chinook	1982	fall run	233,696	22.4	74.4	7.7
Chum	1982	Puntledge	7,380,932	1.5	94.6	1.2
Pink	1982	Puntledge	52,067	-	91.8	.19
Steelhead	1982	winter run	28,957	100.0	39.1	55.0
Steelhead	1983	summer	3,390	--	88.6	15.38
Cutthroat	1982	production	1,692	100.0	56.25	77.0
Nimpkish Hatchery						
Sockeye	1982	Nimpkish	1,633,559	0	71	.15-.70
Chinook	1982	Nimpkish	2,183	0	72	2.34
Coho	1982	Nimpkish	10,005	0	77	1.88
Chum	1982	Nimpkish	288,078	0	40	0.87

Table 21

East Coast Vancouver Island SEP Facilities*: Status at December 1983

Species	Stock	Brood	Stage	No. on Hand	Expected Release Date	Expected Release Number	Expected Release Site
Quinsam River Hatchery							
Chum	Quinsam		egg	6,000	This information not available at time of printing.		
Pink	Quinsam		egg	7,206,700			
Coho	Quinsam		egg	5,027,800			
Coho	Quinsam		fry	1,430,000			
Chinook	Quinsam		egg	1,450,000			
Steelhead	Quinsam		fry	22,000			
Cowichan Band Project							
Chinook	Cowichan	83	egg	335,000	June 1984	301,500	Cowichan
Coho	Cowichan	83	egg	23,657	June 1984	21,291	Cowichan
Chum	Cowichan	83	egg	1,068,416	April 1984	961,574	Cowichan
Nanaimo Community Development Project							
Chinook	spring run	83	egg	71,938	June 1984	64,744	Upper Nanaimo
Chinook	fall run	83	egg	337,861	June 1984	304,075	Lower Nanaimo
Steelhead	Nanaimo	82	smolt	7,660	May 1984	7,660	Nanaimo
Chum	Nanaimo	83	egg	1,032,910	April 1984	929,619	Nanaimo
Coho	Nanaimo	83	egg	210,087	June 1984	189,078	Nanaimo
Chemainus River Hatchery							
Chinook	Chemainus	83	egg	225,000	June 1984	N/A	Chemainus
Coho	Chemainus	83	egg	2,300	June 1984	N/A	Chemainus
Little Qualicum Project							
Chum	L. Qualicum	83	egg	42,000,000	N/A	N/A	L. Qualicum
Coho	B. Qualicum	82	fry	37,900	N/A	N/A	L. Qualicum
Big Qualicum Project							
Coho	B. Qualicum	83	egg	7,021,731	May 1985	1,500,000	B. Qualicum
Coho	B. Qualicum	82	pre-smolt	1,789,000	May 1984	N/A	B. Qualicum
Chinook	B. Qualicum	83	egg	4,000,000	June 1984	3,200,000	B. Qualicum
Chum	B. Qualicum	83	egg	2,826,288	April 1984	2,800,000	B. Qualicum
Steelhead	B. Qualicum	84	adult	three males and one female for brood stock			
Steelhead	B. Qualicum	83	pre-smolt	42,400	June 1984	42,000	B. Qualicum
Steelhead	Englishman	83	pre-smolt	31,779	May-June 1984	31,000	Englishman

*Includes facilities constructed prior to SEP.
N/A means "not available."

Table 21 (Cont'd)

Species	Stock	Brood	Stage	No. on Hand	Expected Release Date	Expected Release Number	Expected Release Site
Puntledge River Hatchery							
Chinook	summer run	83	alevin	706,537	June 1984	695,000	upper site
Chinook	fall run	83	alevin	120,000	June 1984	115,000	lower site
Coho	production	83	alevin	1,400,000	May 1985	1,000,000	upper site
Coho	colonization	83	alevin	4,415,324	June 1984	4,000,000	Comox Lake
Pink	Puntledge	83	alevin	756,900	March 1984	700,000	lower site
Pink	Tsolum	83	alevin	41,900	Jan. 1984	41,150	Tsolum River
Chum	production	83	egg	6,784,066	April 1984	6,500,000	lower site
Coho	production	82	smolt	1,271,653	May 1984	1,270,000	upper site
Steelhead	winter run	82	smolt	31,511	May 1984	31,250	lower site
Northern Vancouver Island Salmon Enhancement Association							
Quatse River Hatchery							
Coho	Cluxewe	83	egg	107,000	Oct. 1984	107,000	Cluxewe
Coho	Quatse	83	egg	53,000	Oct. 1984	53,000	Quatse
Stephens Creek Hatchery							
Coho	Stephens	83	egg	83,600	June 1984	83,600	Stephens
Coho	Waukwaas	83	egg	24,600	June 1984	24,600	Waukwaas
Coho	Wanokana	83	egg	43,750	June 1984	43,750	Wanokana
Chum	Stephens	83	egg	527,000	May 1984	300,000	Wanokana
						227,000	Stephens
Chum	Waukwaas R.	83	egg	63,000	May 1984	63,000	Waukwaas
Nimpkish Hatchery							
Sockeye	Nimpkish	83	egg	3,300,000	April 1984	3,000,000	Willow Cr.
Chinook	Nimpkish	83	egg	116,000	June 1984	55,000	Nimpkish
Chum	Nimpkish	83	egg	601,000	May 1984	550,000	Nimpkish

Table 22

East Coast Vancouver Island SEP Facilities*: Surplus Sales 1983

Species	Amount of Fish (kg)	Eggs (number)	Native Food Fish (pieces)	Value ($)
Quinsam River Hatchery				
Chinook	0	2,000	0	--
Coho	0	120,000	0	--
Pink	0	72,000	0	--
Pink	0	75,000[1]	0	--
Pink	1,507	0	0	60.28
Coho	19,750	0	0	5,499.15
Mixed[2]	440	0	0	13.20
Big Qualicum Project				
Chinook	0	100,000	0	1,000.00
Chinook	0	352,704	0	3,527.00
Coho	0	66,000	0	660.00
Coho	0	25,000	0	250.00
Coho	23	0	0	--
Chum	0	0	8,709	52,254.00
Chum	0	0	12,155	12,155.00
Chinook	0	0	20,804	145,628.00
		0	8	8.00
Puntledge River Hatchery				
Coho (adults)	7,777	0	0	--
Coho (jacks)	5,051	0	0	--
Chum	0	0	1,690	--

*Includes facilities constructed prior to SEP.
N/A means "not available."
[1]Five males and five females were provided for brood stock.
[2]Chinook and coho mixed; usually carcasses.

Table 23

East Coast Vancouver Island SEP Facilities*: Escapement to Facility 1983

Species	Escapement to Facility	Spawned for Hatchery Stock male	Spawned for Hatchery Stock female	% Marked male and female
Quinsam River Hatchery				
Pink	36,845	1,314	5,223	2.33
Coho (adult)	35,056	1,569	2,186	7.61
Coho (jack)	11,438	--	--	24.78
Chinook	2,356	176	254	33.21
Cowichan Band Project				
Chum	N/A	--	--	--
Coho	6	--	--	--
Chinook	captured brood stock	100	116	8
Coho	captured brood stock	24	19	0
Chum	captured brood stock	500	500	0
Nanaimo Community Development Project				
Chinook (spring run)	captured brood stock	34	19	1
Chinook (fall run)	captured brood stock	67	74	38
Coho	1	--	--	0
Coho	captured brood stock	90	118	65
Chum	captured brood stock	132	356	0
Little Qualicum Project				
Chum	31,027	15,224	15,803	777
Chinook	1,884	--	--	--
Chinook	570	318	252	34
Coho	951	501	450	--
Big Qualicum Project[1]				
Chinook (jacks)	2,124	--	--	2.11
Chinook	2,861	763	1,231	6.47
Coho (jacks)	33,265	--	--	2.20
Coho	30,466	4,617	6,285	3.96
Chum	125,410	1,000	950	1.19
Steelhead (wild)	N/A	16	28	0
Steelhead (hatchery)	N/A	8	15	100
Puntledge River Hatchery				
Chinook (summer run)	1,323	842	180	13.0
Chinook (fall run)	219	82	30	29.6
Coho	14,225	1,599	3,286	8.2
Coho (jacks)	13,567	--	--	4.9
Chum	4,537	1,601	2,490	.12
Pink	1,652	764	600	1.5
Pink (Tsolum)	94	63	31	17.0
Steelhead (summer run)	Not available at time of printing.			
Steelhead (winter run)	Not available at time of printing.			

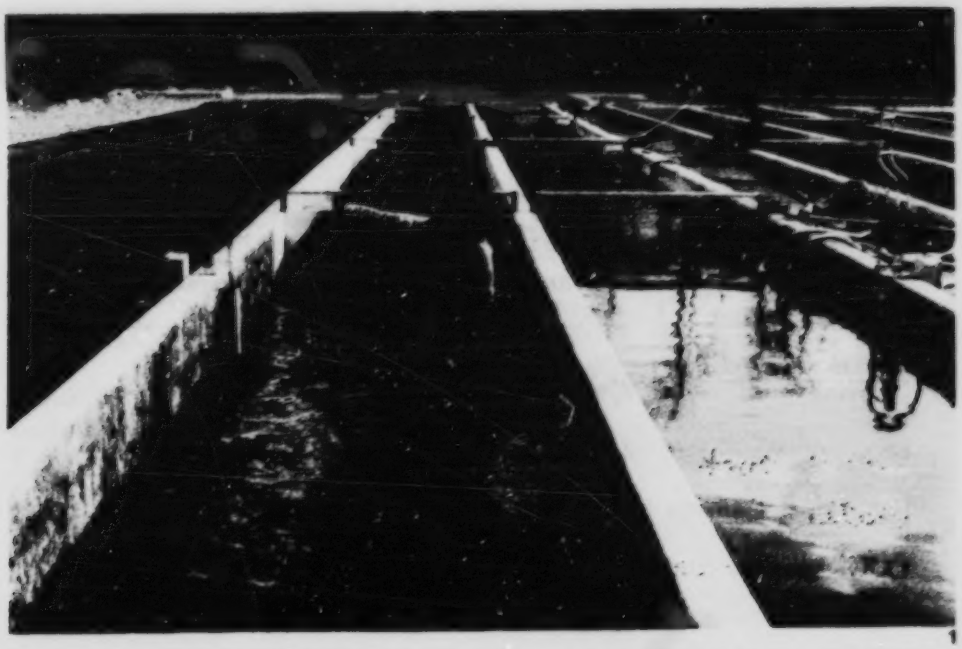
*Includes facilities constructed prior to SEP.
N/A means "not available."
[1]% marked is not representative of entire escapement, e.g., chum % marked was calculated from marked/unmarked ratio from dead pitch spawning channel 2.

Table 24

East Coast Vancouver Island SEP Facilities*: Adult Production

Species	Expected Production from 1983 Releases: Total Adult Production	Years of Return	Contribution to Fisheries	At Full Production: Total Adult Production	Contribution to Fisheries
Cowichan Band Project					
Chinook	7,236	1984-1987	5,789	10,800	8,640
Coho	223	1984-1985	122	10,800	5,940
Chum	10,080	1985-1987	4,435	14,400	6,336
Nanaimo Community Development Project					
Chinook (spring run)	381	1984-1987	304	5,400	4,320
Chinook (fall run)	3,004	1984-1987	2,403	5,400	4,320
Coho	7,970	1984-1985	4,383	10,800	5,940
Chum	10,426	1985-1987	4,587	14,400	6,336
Big Qualicum Project					
Chinook	57,348	1985-1988	37,103	90,000	63,335
Coho	367,500	1985	299,880	N/A	N/A
Chum	588,000	1986	468,356	N/A	N/A
Northern Vancouver Island Salmon Enhancement Association					
Pink	no releases in 1983			40,000	N/A
Chum	no releases in 1983			36,000	N/A
Coho	no releases in 1983			35,000	N/A
Nimpkish Hatchery					
Sockeye	27,360	1986-1987	15,049	58,625	32,244
Chinook	65	1985-1988	45	5,405	N/A
Coho	450	1984-1985	250	6,750	N/A
Chum	4,321	1986-1987	1,985	22,500	10,125

*Includes facilities constructed prior to SEP.
N/A means "not available."



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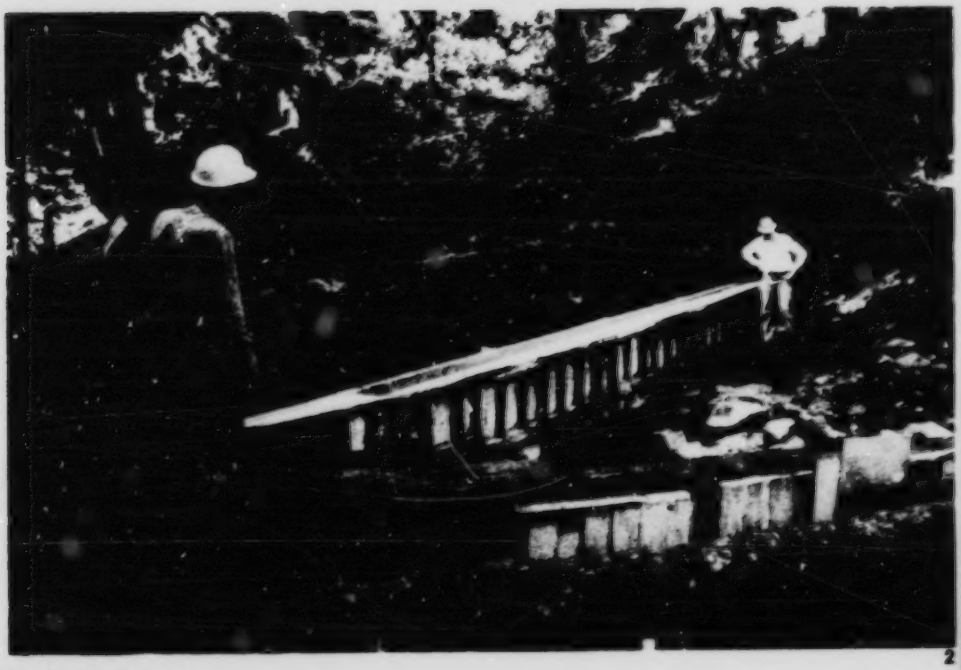


2

Central Coast

1. Getting ready at the new Kitimat production hatchery. The project, one of the most complex of the SEP-built facilities, will enhance a total of 22 different stocks.
2. Pink, coho and sockeye stocks will all benefit from this dam which diverts water from the falls to passable channels on the Koeye River.

Central Coast

Oweekeno Community Development Project

The tiny community of Oweekeno is in an area of the central coast of B.C., approximately 145 km north and 145 km east of Port Hardy. A man by the name of Percy Walkus has been instrumental in convincing the DFO and the Canada Employment and Immigration Commission to work together to begin development of a SEP project in Oweekeno. To this end, Mr. Walkus secured job creation funding to begin training himself and one other individual in the art of fish culture and to plan future SEP enhancement participation for the members of the community. Mr. Walkus participated with the Snootli Creek hatchery manager to collect approximately 86,000 chinook eggs from the Wannock River. These eggs were transported to Snootli Creek for incubation, rearing and eventual transport back to the Wannock estuary for continued rearing and eventual tagging and release in 1984.

In 1984, sea pens will be completed to rear the Wannock River chinook. Accommodation for a project advisor and visiting support personnel will also be completed. A reconnaissance program will commence to locate the best source of water for future hatchery development. One of the new trainees is expected to work with the local fishery officer on spawner escapement counts and other management-related duties.

Contact: Maurice Boisvert, Project Coordinator, Special Projects Division.

Bella Bella Hatchery

Located on Campbell Island, this chum hatchery is the focus for training of four full-time employees of the Bella Bella Band Council, which operates the hatchery under contract. The facility will increase chum salmon available to the central coast commercial fisheries and native food fisheries.

A number of major activities were underway at the hatchery in 1983. An assessment of relative species abundance and a timing of juvenile migration was carried out in April and May and a coho fry salvage of 5,300 was undertaken. These fry, from McLoughlin Creek, were reared at the hatchery and released to McLoughlin Lake in late September. The monitoring at Deer Pass was also continued. In addition, a fry transport pipeline approximately 457 m long was installed to deliver chum fry from the hatchery to the sea pens at McLoughlin Bay. Hydro power will be delivered to the hatchery site in 1984. The building rewiring was completed in 1983.

Of 371,245 chum fry (1.5 gram) released from the sea pens in June, approximately 27,000 were marked with a left ventral clip.

Eggs collected and incubated in 1983 included:

- 1,855,000 Neekas Creek chum eggs
- 45,000 McLoughlin Creek chum (from the first hatchery returnees)
- 20,000 Kajusdis Creek sockeye (to be released in streams of origin in April 1984).

The coho and sockeye were incubated in Heath trays; all chum were incubated in Atkins bulk incubators and gravel keeper boxes.

Since 1979, the project has had a very poor success during the primary incubation stage. It was discovered in 1983 that the newly installed support screens in the chum incubators were

being clogged, resulting in suffocation and mortalities of approximately three-quarters of the total chum egg production. Iron and slime bacteria, coupled with very low pH, are the most likely causative factors identified to date. Inspection of the lake intake structure and a complete revamping of the primary incubation system is planned for next year.

Plans for 1984 include egg collection targets of 2 million chum eggs (to be collected entirely from hatchery stock escapement to McLoughlin Creek) and up to 100,000 coho eggs from a number of local streams. The hatchery also plans construction of a brood stock collection facility at McLouglin Creek for chum returnees, completion of a flow control weir on the creek, modification of the primary incubation system, installation of an alarm system, construction of adult coho holding compartments and modifications to the water distribution system. As well, the surveys of downstream timing and migration, the abundance assessment and the coho fry salvage will continue.

Contact: Maurice Boisvert, Project Coordinator, Special Projects Division.

Hartley Bay Band Project

The Hartley Bay Band is developing a small hatchery on Hartley Bay Creek in their village, located approximately 130 kilometres southeast of Prince Rupert. They have entered into contracts with the Departments of Fisheries and Oceans; Employment and Immigration; Indian Affairs and Northern Development to undertake this project. Between one and seven people have been employed under the various programs for approximately four person-years of employment. These people receive on-the-job training and attend courses available as part of the CEDP program.

In 1983, 18,000 coho were reared to four-gram size in Capilano troughs and released into a lake above the village where they will rear until spring 1984. Fry-to-smolt survivals of similar plants above barriers to fish passage in barren lakes in Alaska were 50 - 75 percent; however, the Hartley Bay lake contains trout, known predators of juvenile salmon so fry-to-smolt survival may be reduced. Close monitoring of this project for a few years will determine the applicability of expanding this technique to the large number of lakes inaccessible to salmon in the Hartley Bay area.

Juvenile trapping in 1983 indicated good growth and survival of the marked hatchery fish. At the present time 65,000 coho alevins are being incubated in temporary facilities for release above the barrier in June 1984. Plans for 1984 include continued monitoring of the outplants and completion of the hatchery facility.

Contact: Bruce Wright, Project Coordinator, Special Projects Division.

Klemtu Project

In 1983, the Salmonid Enhancement Program initiated a formal contract with the Kitasoo Band Council to manage the development of a project at Klemtu located approximately 80 km north of Bella Bella. This development is a joint venture between DFO and the Canada Employment and Immigration Commission's job creation initiatives.

To date, CEIC has contributed the bulk of the labor, operating, capital and training expenses to develop personnel and the enhancement facility in the village of Klemtu on Kitasoo Creek. A hatchery building was constructed using lumber milled at Klemtu. It consists of an indoor rearing area, incubation room and office space. A 10 cm pipeline was installed to use the village water supply. Tentative production targets are one million chum and 250,000 coho. Hatchery staff were involved in juvenile salmon downstream monitoring assessment, stream clearance, adult reconnaissance and hatchery and pipeline construction.

Sea pens were developed to enable short-term saltwater rearing of the chum salmon before release. In 1983, 31,640 chum fry were released from the sea pens at Klemtu, representing an egg-to-fry survival of 73 percent.

It was a very poor year for coho escapement in the area and, as a result, no eggs were collected. A total of 159,537 chum eggs were collected and incubated in the new facility. Freezing of the Heath tray drains resulted in mortalities to about half of the eggs.

In 1984, the facility will be upgraded and the pipeline insulated. There will be continued assessment of juvenile migration timing and of relative species abundance. A hatchery strategy with long-term production objectives will be defined. Rearing and incubation facilities will be increased and upgraded. Personnel will attempt to collect up to 500,00 chum and up to 100,00 coho eggs this fall. Trainees will be offered a variety of courses in fish culture throughout the year. The 1983 brood chum are expected to be released from the sea pens in May 1984.

Contact: Maurice Boisvert, Project Coordinator, Special Projects Division.

Snootli Creek Hatchery

Snootli Creek hatchery is located 15 km east of Bella Coola at the head of North Bentinck Arm on the central coast. It is a Japanese-style hatchery with an expected capacity by 1986 of 7.2 million reared fry. The hatchery was completed in 1979 and production is currently ahead of schedule, with over 7 million chum fry and 586,000 chinook fry.

In 1983, approximately 6.4 million chum eggs were taken from four stocks of the Bella Coola system: Salloomt River, Thorsen/Nuhaulk, Snootli and Fish/Air Creeks. An additional 1.4 million chum eggs were taken from the Necleetsconnay River, which flows into North Bentinck Arm about 0.5 km northwest of the Bella Coola River. Eggs were incubated separately and resultant fry were segregated throughout rearing prior to release back into their native streams. Fish from the 1980 and 1981 releases are expected to contribute over 40,000 adult chum to the 1984 return. These will be harvested in the commercial and native food fisheries and will also supplement the brood stock available for hatchery egg-takes.

With the help of three COSEP students and seven secondary school students from the Nuxalk Indian Band, all of the streams in the Bella Coola area were checked regularly for tagged fish. Three- and four-year-old chum from the 1979 and 1980 broods were sampled and enumerated. Although data analysis has not been completed, this sampling program promises to provide valuable information on fry-to-adult survival rates.

The chinook and coho programs begun in 1981 continued in 1983. Returns from the Atnarko River pilot hatchery continued to make a significant contribution to current runs. Decreasing returns of Bella Coola River coho prompted continued hatchery production.

For the past three years, Snootli Creek hatchery has cooperated with the provincial Fish and Wildlife Branch in the Salloomt River steelhead fry stocking program. This program was expanded to include several other tributaries of the Bella Coola River in 1983 (primarily the Atnarko, Noosgulch and Nusatsum Rivers and Tatssquan Creek). A small experimental group of 1981 brood steelhead were released to the lower Salloomt River in May.

Approximately 88,000 Wannock River chinook eggs were incubated at Snootli Creek. Resultant fry will be reared for a short time, coded-wire tagged and returned to the Wannock River estuary for release.

The Bella Coola Save the Salmon Society was provided with 30,000 eyed chum eggs for planting in an upwelling

gravel incubator. Resultant fry will be released to Tatsquan Creek to re-establish a chum salmon stock adversely affected by urbanization.

Several experimental studies were conducted in 1983:

- keeper channel density studies were undertaken to determine if the capacity of the hatchery could be increased through more efficient use of existing facilities
- over half a million chum eggs from the Snootli Creek stock were incubated in a temporary keeper channel under a walkway between the rearing ponds. These eggs were supplied with Snootli Creek surface water throughout incubation. Resultant fry were allowed to emerge and swim out of the hatchery unfed. Survival to emergence was 82 percent. A group of these were marked, so that the potential for increasing hatchery production through the release of unfed fry can be assessed
- a pilot study to rear 300,000 Necleetsconnay River chum fry in net pens located in the estuary of the Necleetsconnay River was initiated. A portion of these fish were marked, to assess the potential for increasing hatchery production through the use of sea pens.

The supplemental rearing and holding facilities for chinook, coho and steelhead constructed in 1982 were enclosed in a "tank farm" building, primarily through the efforts and cooperation of a job creation crew.

Well-depth indicators and flow metres were installed on each of Snootli Creek hatchery's production wells. Packed column aerators were installed on all well water used for rearing. These improvements should provide a more consistent well water supply for increasing rearing densities.

Contact: Russ Hilland,
Stock Enhancement Officer,
Enhancement Operations.

Koeye River Diversion

The Koeye River is located on the central coast 10 kilometres south of Namu. Below Koeye Lake, the river branches into three channels. One of these channels flows over a near-vertical 10 metre waterfall; the center channel flows rapidly over a steep, but passable, section and the left bank channel takes a longer, easier path. Approximately 20 years ago, a rock and timber dam was built downstream of the obstructed channel. Over the years, this dam has been damaged by floods and is now completely gone. This led to serious injuries and delays for a large number of pink, coho and sockeye, which would enter the channel and attempt the falls before falling back.

In 1983, two concrete stub walls were built which diverted the flow. (All access to the area was by plane or helicopter.) A tent camp was established on Koeye Lake and the crew travelled by rubber boat to a point where the one kilometre "Gunga Trail" began. Most materials, including pallets of premixed concrete, a compressor and concrete mixer, were lifted by a Bell 214 helicopter, from a barge ten kilometres away at the river's mouth. The concrete walls were built to stop water flowing over the falls during normal migration time. This water was diverted to the other two passable channels.

Evaluation and assessment of the project was completed for 1983. Injuries and migration delays were eliminated for pink salmon; this should increase production for the commercial fishery. Fishery patrolmen and SEP reconnaissance staff will continue to monitor the diversion's effectiveness.

Contact: Al Moore,
Senior Engineering
Technician,
Engineering Division.

Burke Channel Reconnaissance

IEC Beak Consultants Ltd. undertook baseline spawner studies on the Kwatna, Quatlena, and Nootsum Rivers in Burke Channel in 1983. These were to have been followed by complementary juvenile studies; however, they were cancelled on the basis of manageability concerns identified by the Central Coast Management Workshop held in early 1983.

Contact: Bruce Shepherd,
New Projects Coordinator,
Enhancement Operations.

Kitimat Hatchery

This major new production facility, operational in the fall of 1983, is located three kilometres south of Kitimat and 300 metres downriver of the Eurocan pulp mill water intake, on the Kitimat River. One of the most complex facilities yet constructed, Kitimat hatchery is designed to enhance nine chum stocks, seven chinook stocks and four coho stocks within the Kitimat River system and Kitimat Arm (Kildala and Dala Rivers and Bish Creek). Pink salmon and steelhead trout will also be enhanced.

Each stock will be kept separate within the hatchery and returned to donor streams for imprinting and release.

A variety of hatchery techniques are being used in this facility:

- for chum; modified Atkins incubation to the eyed stage, Japanese keeper channels to hatch, Japanese rearing channels to release
- for chinook, coho and steelhead; Heath tray incubation, Capilano rearing troughs for initial rearing, and raceways for final rearing
- for pink salmon; Pallant box incubation, then release.

Total production goals are:

- 11 million chum eggs; 158,400 total adult production
- 3 million chinook eggs; 64,500 total adult production
- 592,000 coho eggs; 60,000 total adult production
- 55,000 steelhead eggs; 1,000 total adult production
- 500,000 pink eggs; 10,000 total adult production.

Many modern technological features are incorporated into the facility. For example, through a five-year contract agreement with the Eurocan Pulp and Paper Co., 4,560/L/min. of hot water (40 - 60°C) is supplied through a complex system of automatic valves and controls, and is pumped through a mile-long pipeline to the hatchery. At the hatchery, automatic controllers and pressure sustaining valves regulate the amount of hot water to be mixed with either well water, surface water or filtered water, depending on the requirements at the time. The required temperature is set on a dial in the control panel and within seconds water at the desired temperature for rearing or incubation is produced. Without this hot water system, the hatchery would only be a small-scale groundwater facility. The hot water from Eurocan is also used in a heat reclamation unit to provide heat to the 3,200 m^2 hatchery building and to keep the river water intake structure free of ice buildup during winter months. An excellent working relationship has been developed with Eurocan personnel who are dedicated to the success of the hatchery and in particular to the operation of the hot water system.

The provision and use of this waste hot water is an energy-saving feature. The cost is far below the estimated capital cost and projected operational costs of heating by other conventional means.

In the calendar year 1983, approximately $3.3 million worth of construction was performed, which substantially completed the $9.62 million facility. The intake, rearing raceways, aeration tower, groundwater wells, and the Eurocan heat transfer systems were all completed.

In August, the engineering start-up of the hatchery commenced. It was a formidable task coordinating the efforts of four consultants, three general contractors, eight subcontractors and numerous suppliers to interconnect and commission all the hatchery components.

This was successful and by late September, the first eggs were transferred to the hatchery.

Although the hatchery is operating well, it has not been problem-free. A persistent break in the Eurocan hot water line necessitated removal and reinstallation of approximately 200 m of pipe within an encasement culvert under the highway and railway. This meant interrupting the hot water flow during December.

For 1984, minor construction is planned, including putting up a storage building, installing a chainlink fence, and drilling an additional 250 mm groundwater well to supplement the existing supply of filtered water.

The objective is to enhance 22 separate stocks in the area. An excellent start to hatchery operations was made in 1983. In total, 1.1 million six-gram chinook will be released to the Kitimat, Hirsch, Dala and Kildala Rivers in May 1984. Production levels have also been reached for coho in the Kitimat system in the first year of operation. Chum returns to the area were very poor, and no chum eggs were taken.

Sport, commercial and native fisheries will benefit significantly from the production of fish at Kitimat hatchery.

Contact: Gregg Morris, Senior Project Engineer, Engineering;
Dave McNeil, Stock Enhancement Officer, Enhancement Operations.

Central Coast Reconnaissance/ Feasibility

In 1983, bio-engineering reconnaissance/feasibility studies were continued in the central coast of B.C. to investigate enhancement opportunities and begin active planning for Phase II of SEP.

Specifically, two river systems, the Kwatna and Nekite were investigated. On the Kwatna, two excellent spawning channel sites were identified, with channel lengths of 7,620 meters and 4,572 meters. On the Nekite, a hatchery site with a gravity surface water supply has been identified. As well, a site to construct a 1,219 and 1,524 meter long side channel has also been identified. A consultant was retained to undertake aerial photography and topographic mapping of the potential sites on both river systems. Preliminary channel layouts have been done on the Kwatna site and hatchery sizing for the Nekite system.

In 1984, the following work is proposed:

- Kwatna River: no further bio-engineering, work will be carried on until management test fishing is completed
- Nekite: access to the potential enhancement sites will be improved. Test hole program to be undertaken in the summer and flow studies conducted throughout the year
- South and North Bentick Arm: enhancement opportunities investigation and review
- Atnarko River: spawning channel investigation and surveys
- Salloompt River: obstruction investigation
- Rivers Inlet: further basic reconnaissance.

Contact: Otto Rapp, Senior Project Engineer, Engineering Division;
Bruce Shepherd, New Projects Coordinator, Enhancement Operations.

Provincial Status Report

Atnarko/Bella Coola Steelhead Enhancement - Salloomt River Fry Stocking

During the 1970s, returns of steelhead to the Bella Coola system declined considerably, mainly due to overharvesting by the sport and native fisheries as well as habitat degradation. Starting in 1981, several enhancement projects were undertaken on the system to increase steelhead production and thereby restore angling activity to former levels.

The primary enhancement project on the Bella Coola system involves a six-year headwater stocking program on the Salloomt River. The objective of the program is to establish steelhead in previously unused rearing habitat above a set of impassable falls. The barrier will be removed eventually, thus allowing the population to become self-perpetuating. In 1981, 79,000 fry were released and in 1982, 49,000 fry were liberated to the Salloomt River.

Other enhancement projects which have been undertaken include rehabilitation of a well-used spawning area on Camera side channel (Atnarko River) and a steelhead fry stocking program on Hotnarko Lake (upper Atnarko watershed) which was started in 1982. The objective of the program is to use this previously barren lake as a rearing area for juvenile steelhead. It is expected that not all the released steelhead will migrate to the ocean; fish that residualize will provide a trophy trout fishery in the lake. Approximately 24,000 fry were released in 1982.

In 1983, the third steelhead fry release of a six-year program was undertaken on the Salloomt River. Brood stock was obtained from the Bella Coola River. Adult holding, incubation and rearing were carried out at Snootli Creek hatchery. In addition to the fry release, steelhead smolts were liberated into the lower Salloomt River in May 1983.

Fry releases were also undertaken on four other tributaries of the Bella Coola system as well as Hotnarko Lake.

In early September, the survival and growth of fry released in the Salloomt were assessed, and Camera Channel was surveyed to enumerate spawning steelhead and to determine the extent of spawning platform use.

During March - May, 1983 a total of 145,000 eggs were taken from Bella Coola River brood stock. Approximately 132,000 unfed steelhead fry were released into Bella Coola tributaries (Salloomt R, 61,500; Atnarko, 37,000; Hotnarko Lake, 15,000; Noosgulch R., 9,500; Nusatsum, 6,000; Burnt Bridge Cr., 3,000). The expected return of adults (in 1988-89) is 1,000 - 1,200 adults.

Approximately 7,500 smolts were released to the lower Salloomt in May. The expected return, in spring 1985, is 200 - 250 adults.

In May 1983, 67 adult steelhead were observed using the spawning platforms in Camera Channel (other areas of the channel were not surveyed due to turbid water conditions). In mid-August, 211 redds were counted in the channel, of which 115 were on introduced gravel.

Fry stocking planned for 1984 is as follows:

Salloomt River	60,000
Atnarko River	35,000
Noosgulch River	20,000
Hotnarko Lake	10,000
	125,000 fry.

Other work will include the possible removal of Salloomt River falls, the continued assessment of growth and survival of Salloomt River fry, assessment of the Camera Channel spawning platform and steelhead reconnaissance on South Bentinck tributaries.

Contact: Tom Wilkinson, Fisheries Technician, Fish and Wildlife Branch, Williams Lake.

Salloomt River Fry Stocking Assessment

The lower 4.5 km of stream is accessible to anadromous fish but an impassable barrier prevents upstream migration to a further 17 km. Prior to 1981, the area above the barrier was occupied only by resident Dolly Varden char. A study was carried out to determine the feasibility of stocking steelhead fry above the barrier. This was followed by an assessment of the carrying capacity to maximize benefits from released fry.

Four consecutive years of study have now been completed. Work in 1983 was concerned with obtaining clarification of steelhead fry carrying capacity in the absence of flood conditions and an estimation of survival to parr.

An estimated 60,500 steelhead fry of two size groups were released July 29, 1983 at 10 sites in the mainstem Salloomt above the barrier. An additional 1,000 were liberated below the barrier as in previous years. Approximately 6,700 grade-down chinook juveniles were liberated on July 5 by Snootli hatchery staff.

In 1980, a preliminary biophysical assessment of the Salloomt River and an estimate of the benefit/cost of barrier removal was carried out.

On the basis of this investigation, a steelhead fry stocking program was initiated in the summer of 1981. Objectives of 1981 releases and follow-up population assessment were:

- to determine relative survival rates of early (unfed) versus late (fed) fry
- to ascertain whether predicted carrying capacity could be attained.

Unpredictable delays in release timing and subsequent assessment led to unreliable results brought about by confounding effects from cold water temperatures and resultant overwintering behavior.

Both stocking and assessment programs were continued in 1982.

Statistical comparisons of 1982 recaptures indicated no benefits had been derived from hatchery rearing to fall fry stage in 1981. Late fry releases were discontinued, and liberations were scheduled during the period of normal wild fry emergence for this system. Due to the unknown influence of post-release flooding in 1982, some uncertainty existed over whether fry saturation had been achieved at all sample sites. Results implied a maximum capacity of less than half the 0.22 fry/m^2 originally predicted. A large portion of the discrepancy between predicted and sampled densities was related to presence of high water velocities and depths which would limit total rearing habitat for fry, even under normal flow conditions.

The results of the investigations showed that:

- steelhead fry densities ranged from 0.07-0.32 fish/m^2 or 0.08-0.44 g/m^2 in stocked sites. Fry densities in two of three repeat Reach 5 sites were lower than in the previous fall
- a regression on 1983 fry data, and calculated probability-of-use, showed no relationship similar to that observed in 1982. The relationship did hold for parr. It is possible that 1983 fry densities were influenced by factors other than those measured at time of sampling and that saturation was not achieved at all sites
- fry quality as indicated by a difference in condition factor between the two groups of fry released (0.94×10^{-5} compared to 0.76×10^{-5}) may be a prime factor, as low-condition fry were used to seed the Reach 5 sites
- highest parr densities were sampled in Reach 3 at 0.14 fish/m^2. High parr densities were associated with depth >0.30 m, surface velocities >40 cm/s, and boulder cobble substrate
- 795 parr were observed during the 2.5 km snorkel survey for an average of 318/km. Based on snorkel observations, fall fry to parr survival is estimated at 20-30 percent. Smolt production for Reach 5 is now estimated to be 35-42 percent of the original prediction
- growth slope calculated was 11.5, slightly higher than predicted by the

growth model used. Higher than expected growth slope may reflect disproportionately greater mortality among the smaller fry liberated

-grade-down chinook released above the barrier appeared to do very well. Growth slope was calculated at 10.5, compared to a mean recorded temperature of 11.0°C (which indicates good growth). Survival cannot be estimated from the data.

The failure to obtain uniform densities between 1982 and 1983 is not believed to be due to a reduction in carrying capacity. Uncertainty still exists over whether fry saturation has been achieved at all sites. The assessment program should continue, if possible, in order to fine-tune the stocking rate to provide optimum production.

A Marsh-McBirney (Model 201M) flow meter and top levelling rod should be used to collect more accurate measurements of depth and velocity across the entire wetted width of specific hydraulic units. This information would be useful in developing a system-specific habitat rating curve to clarify understanding of maximum sustainable fry population for this system.

In light of restraint, further assessment work may be limited; however, the Salloomt data have become valuable in fish abundance/habitat quality modelling for the province as a whole.

Smolt yield and subsequent adult returns will likely be less than half of the original estimate (680 at 8 percent smolt to adult survival or 1,020 at 12 percent survival). The first major adult steelhead returns are expected in 1986. Based on snorkel survey estimates of survival to parr (35-42 percent of the original prediction) and 8-12 percent smolt to adult, between 240-430 adults would be anticipated. Since the original estimate of benefits appears to be high, barrier removal has yet to be justified.

Contact: Ron Ptolemy,
Fisheries Biologist,
Fish and Wildlife Branch
Victoria.

Job Creation Projects

McLoughlin Bay/Deer Pass Development

The goal of this project was to support the development of a hatchery at Deer Pass and to help in the operation of the McLoughlin Bay facility. Both facilities are operated by the Bella Bella Council under the Community Economic Development Program.

The 17 workers constructed a flow control weir on McLoughlin Bay Creek, assisted in hatchery operations, and conducted public tours of the facilities. They also started construction of the Deer Pass hatchery.

Hartley Bay Hatchery Site

This project was set up to help develop a pilot salmon hatchery at Hartley Bay, located 125 kilometers southeast of Prince Rupert on Wright Sound.

The work included clearing the site, construction of a boardwalk and milling most of the materials for a longhouse-style hatchery building. The five-person crew also helped rear salmon fry, set up temporary incubation facilities and captured coho brood stock.

Hartley Bay Hatchery

This project contributed to both information and facilities needed for the continued development of the enhancement project at Hartley Bay. The three employees were involved in a number of activities:

- continued construction of the hatchery building
- fry trapping to evaluate success of coho fry outplants
- construction of downstream and upstream traps for enumeration of brood stock capture
- installation of a new water supply pipeline.

Snootli Creek Hatchery

The 10 workers on this project helped expand the facilities at Snootli Creek hatchery near Bella Coola. They put in separate rearing channels for coho and steelhead, enclosed the outdoor rearing troughs, completed the

boat shed, and built a fire station. As well, public facilities were improved.

Klemtu Juvenile Sampling and Bioreconnaissance

Sixteen workers prepared a site for a hatchery at Kitasoo Creek. They built and operated a counting fence on the creek for estimating numbers, timing, and quality of chum fry. They also installed and operated three juvenile traps in the Mary Cove-Lagoon Creek area to estimate the timing and quality of sockeye, coho, pink, and chum juveniles. Water quality, temperature, and flows were monitored at the hatchery site.

The Kitasoo Band will operate the facility as part of the Community Economic Development Program.

Contact: Colin Masson, Project Coordinator, Special Projects Division.

Table 25

Public Participation Projects

CENTRAL COAST PUBLIC PARTICIPATION PROJECTS

Location	Name of Group	No. of People Involved in 1985	No. of Years Group Involved in SEP	Type of Project	Species	Juveniles Released	% Survival	Expected Adult Production from 1985 Releases
Klemtu Creek	Klemtu School	25	4	incubation in school	coho	Eggs died due to overloading.		
Hartley Bay Creek	Hartley Bay School	60	6	incubation	coho	30,500	79	732
Dona River	Dona River Community Association	25	3	incubation	coho	12,000	80	180

Contact: Barry Peters, SEP Community Advisor.

Table 26

Central Coast SEP Facilities: Juvenile Releases 1983*

Species	Brood	Group	Total Released	% Marked	% Survival	Average Size(g)
Bella Bella Hatchery						
Chum	1982	Neekas Cr.	371,245	7	39	2.0
Coho	1982	McLoughlin Cr.	5,246	0	99	8.0
Hartley Bay Band Project						
Coho	1982	Hartley Bay Cr.	18,000	100	56	4.0
Snootli Creek Hatchery						
Steelhead	1981	Atnarko R.	2,343	100	100	56.4
Steelhead	1981	Atnarko R.	5,258	100	100	20.9
Kitimat Pilot Hatchery						
Chinook		Hirsch	46,310	99	N/A	4.67
Chinook		Kitimat R.	44,759	96	N/A	5.56
Chinook		Kitimat R.	198,500	0	N/A	3.86
Chinook		Kitimat R.	1,757	0	N/A	1.50

*Includes facilities constructed prior to SEP.
N/A means "not available."

Table 27

Central Coast SEP Facilities*: Status at December 1983

Species	Stock	Brood	Stage	No. on Hand	Expected Release Date	Expected Release Number	Expected Release Site
Bella Bella Hatchery							
Chum	Neekas Cr.	83	egg	1,850,000	May 1984	300,000	McLoughlin Bay
Chum	McLoughlin Cr.	83	egg	45,000	May 1984	25,000	McLoughlin Bay
Coho	McLoughlin Cr.	83	egg	2,500	Aug. 1984	2,000	McLoughlin Lk.
Sockeye	Kajusdis Cr.	83	egg	20,000	May 1984	18,000	Kajusdis Lk.
Hartley Bay Band Project							
Coho	Hartley Bay Cr.	83	alevin	65,100	June 1984	60,000	Hartley Bay Cr.
Snootli Creek Hatchery							
Chinook	Atnarko	83	alevin	578,100	June 1984	N/A	Atnarko R.
Chinook	Wannock	83	alevin	88,000	June 1984	88,000	Wannock R.
Chum	Saloomt	83	alevin	2,043,800	March 1984	2,028,499	Saloomt R.
Chum	Snootli	83	alevin	1,522,835	March 1984	1,522,800	Snootli Cr.
Chum	Fish/Air	83	alevin	1,708,188	March 1984	1,644,723	Fish/Air R.
Chum	Thorsen	83	alevin	940,869	March 1984	937,803	Thorsen
Chum	Necleetsconnay	83	alevin	1,356,650	March 1984	1,344,176	Necleetsconnay
Coho	Bella Coola	83	egg	107,449	July 1984	107,400	Bella Coola system
Steelhead	Atnarko	83	adult	Seven adults on hand should produce 140,000 fry for release in August 1984.			Atnarko
Kitimat Hatchery							
Chinook	Kitimat	83	egg	935,600	May 1984	N/A	Kitimat
Chinook	Dala	83	egg	54,200	May 1984	N/A	Dala
Chinook	Kildala	83	egg	114,600	May 1984	N/A	Kildala
Chinook	Hirsch	83	egg	59,100	May 1984	N/A	Hirsch
Coho	Kitimat	83	egg	600,000	N/A	N/A	Kitimat

*Includes facilities constructed prior to SEP.
N/A means "not available."

Table 28

Central Coast SEP Facilities* Escapement to Facility 1983

Species	Escapement to Facility	Spawned for Hatchery Stock male	Spawned for Hatchery Stock female	% Marked male and female
Kitimat Hatchery				
Chinook	0	142	152	0
Coho	0	290	123	0
Bella Bella Hatchery				
Chum	600	23	23	0

*Includes facilities constructed prior to SEP.

Table 29

Central Coast SEP Facilities*: Adult Production

Species	Expected Production from 1983 Releases: Total Adult Production	Years of Return	Contribution to Fisheries	At Full Production: Total Adult Production	Contribution to Fisheries
Hartley Bay Band Project					
Coho	245	1984-1986	183	N/A	N/A
Snootli Creek Hatchery					
Chum	40,000	1985-1987	N/A	N/A	N/A
Chinook	750	1985-1988	N/A	N/A	N/A

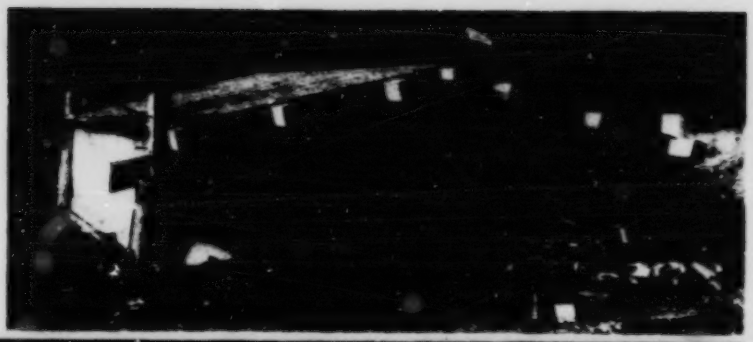
Kitimat Hatchery
First egg-takes in fall 1983.

Bella Bella Hatchery
Not available at time of printing.

*Includes facilities constructed prior to SEP.
N/A means "not available."

Queen Charlottes

1. *The longhouse at King Creek accommodates incubation and rearing facilities.*
2. *Members of the Masset Band place one of the four massive corner posts for the longhouse.*



Queen Charlotte Islands

Pallant Creek Hatchery

Pallant Creek hatchery is located 48 km south of Sandspit, on Moresby Island. This modified Japanese-style chum hatchery was constructed in 1978. The site includes incubation facilities for 10 million eggs; 64 upwelling gravel boxes and four concrete raceways. Approximately 4 km from the hatchery, in the estuary, floating net pens are located. They are capable of rearing 5 million chum to 1-gram size.

As well as chum, coho and steelhead are also incubated and reared at the facility. Chum are reared at the sea pens, but coho and steelhead are reared at the hatchery in fresh water. These are then released into the upper and lower watershed at a size varying from 2 to 5 grams. In fall 1983, 500,000 pink eggs were also taken for an experimental rearing program, to test rearing survival in salt water versus fresh water. Good success in salt water was observed. In spring of 1983, coho were outplanted into the upper watershed. (Adults are unable to utilize the spawning habitat which exists above an impassable falls located 1.5 km below Mosquito Lake.) Adult coho returns in 1983, from previous releases in the upper watershed, proved very successful, contributing to both the commercial and sport fisheries.

Contact: Pat Slobodzian, Stock Enhancement Officer, Enhancement Operations.

Mathers Creek Pilot Hatchery

Mathers Creek pilot hatchery is located 10 km south of Beattie Anchorage on Louise Island. Construction of the facility began in 1980. The objective of the facility is to determine the feasibility of enhancing Mathers Creek chum, pink and coho salmon. This is intended to mitigate the increased fishing pressure from the terminal Cumshewa Inlet fishery for Pallant Creek hatchery returns. At present the Mathers Creek pilot is being operated as a satellite to Pallant Creek hatchery.

The 1982 brood Mathers Creek eggs were incubated on-site in Heath trays and upwelling gravel boxes. After swim-up, the fry were reared in vinyl-lined raceways until the time of release. A total of 608,948 fish was released directly into Mathers Creek on two release dates in May 1983. There were no other releases from Mathers Creek during 1983.

During the 1983 fall program, 700,000 chum eggs were collected from approximately 300 females. The total chum escapement to Mathers Creek was estimated at 2,350 adults. Approximately 80 percent of the returning chum were three-year-olds and the remaining 20 percent were four-year-olds. All Mathers Creek eggs were transported to Pallant Creek hatchery for incubation. The swim-up fry will be airlifted back to Mathers in early 1984 for rearing and imprinting before release into Mathers Creek.

Fall 1983 marked the first year of returns from the 1980 brood Mathers Creek releases. Of the 914 fish handled, 132 were clipped. However, the overall escapement suggested that sur-

vivals of the first brood did not meet expectations. Survivals of the following years are expected to improve over that of the pilot year of operation.

Contact: Pat Slobodzian, Stock Enhancement Officer, Enhancement Operations.

Skidegate Community Development Program

The Skidegate Band, on the Queen Charlotte Islands, currently employs three band members to work on their SEP project. Two are employed under the Local Employment Assistance Program and the third is employed under the CEDP contract.

A pilot incubation and rearing project on Slarkedus Creek near Skidegate resulted in the release of 1,000 fry. At the present time, 18,000 coho alevins are being incubated at the village site and 17,500 sockeye are being incubated in midwater lake incubators, in Skidegate Lake on Moresby Island. This is an experimental technique which will be evaluated and continued if it proves to be effective.

Other activities in the past year included operation of a counting plate and a downstream trap to assess adult sockeye and smolt migration, both into and out of Skidegate Lake. In addition, on the job and formal training continued for the project manager.

Next year will see continued rearing of some of the coho to smolt size and a reconnaissance program to identify fry outplant opportunities. Chum will be incubated in a new upwelling incubator on Tarundl Creek, west of Queen Charlotte City. The sockeye program will again include the counting plate, downstream trap, lake incubators and/or conventional upwelling incubator box.

Contact: Bruce Wright, Project Coordinator, Special Projects Division.

Masset Community Development Project

The Masset Indian Band operates a project on the Yakoun River system, under contract with SEP. The project consists of a hatchery located at King Creek and net pens on Marie Lake for rearing. In 1983, the Band released 212,000 Yakoun chinook fry, 46,000 coho fry from three different tributaries and 13,000 sockeye fry. The facility is currently incubating 89,000 chinook, 137,000 coho and 13,000 sockeye eggs.

Brood stock fishing for chinook proved very difficult this year due to low escapement and high water. Survival of eggs to the eyed stage was excellent. This year, Heath tray incubators replaced upwelling gravel incubators in an attempt to improve survival and increase hatchery capacity. The sockeye continue to be incubated in an upwelling box, which was moved this year to improve water flow.

A longhouse was constructed to house incubation and rearing facilities, store equipment and provide extra accommodation for part-time crew. This work was funded through job creation programs and a capital grant from Department of Indian Affairs, Economic Branch.

The project provides four full-time jobs and two person-years of part-time employment (eight jobs) for the Masset Band. As well as on the job training, project workers receive classroom training in various aspects of salmon enhancement and project management.

Contact: Bruce Wright, Project Coordinator, Special Projects Division.

Provincial Status Report

Pallant Creek Steelhead

The life history characteristics, population estimate and enhancement options of Pallant Creek steelhead, are

being studied by a cooperative project of the Queen Charlotte Island Chapter of the B.C. Steelhead Society, the Dept. of Fisheries and Oceans and the Fish and Wildlife Branch.

The Pallant Creek drainage is located on the east coast of Moresby Island.

The construction of a federal hatchery and a proposal to blast a barrier on Pallant Creek prompted an in-depth study of steelhead trout in this actively fished lake and stream system. Steelhead brood stock were captured from Pallant Creek and eggs incubated at the hatchery. Fry (1.6 grams) were subsequently released (5,128 in 1982, 7,200 in 1983) upstream of the barrier in tributaries to Mosquito Lake in an attempt to colonize this area prior to falls removal.

In 1983, unmarked fry were released in both pond and stream habitats while in the previous year ('82), 4,174 marked fry were distributed in lake tributary streams only. During the 1983 mid-summer low flow period, extensive sampling was conducted throughout fry release sites in an attempt to ascertain fry survival and thus determine the most successful stocking strategy. Gee minnow traps, electrofishing and nets were used to locate parr from the 1982 fry release and fry of the spring 1983 release.

Multiple catch and recapture data of adult steelhead angled during the 1980-81 winter season was compared to a steelhead smolt model based on habitat. The latter was measured in 1983.

Although extensive areas were sampled, only one steelhead parr of the 1982 fry release project was collected. Stocked steelhead fry-to-parr survival was considered minimal. This was attributed to unstable over-wintering conditions in lake tributary streams and possible interactions with juvenile Dolly Varden char, cutthroat and coho populations. Mid-summer sampling indicated a redistribution of 1983 fry from point of release sites to riffles and pools at varying densities. Average fry density in pools was .99/m^2 while in riffles it was .89/m^2. The data are inconclusive however, due to the small number of samples. Monitoring of released and natural steelhead and other salmonid juveniles of the Pallant system will continue in 1984 to clearly identify the limitations and possible conflicts of proposed enhancement options.

The smolt model based on the quantity and quality of habitat in Pallant Creek calculated an average potential run of 267 adult steelhead. Comparable results were obtained from the 1980-81 mark and recapture project where a population range of 364, 263, 328 adult steelhead were estimated to be in the system during the sampling period. Life history characteristics derived from scale interpretations have not been finalized.

Mosquito Lake Cutthroat - Coho Interaction

This study, a cooperative project of the Queen Charlotte Islands Chapter of the B.C. Steelhead Society, Dept. of Fisheries and Oceans and the Fish and Wildlife Branch, is funded by the New Economic Expansion Program.

Mosquito Lake is part of the Pallant Creek drainage on the east coast of Moresby Island.

In an effort to increase salmonid production of Pallant Creek, 32,387, 114,597, and 349,222 coho fry were distributed during 1981, 1982 and 1983 respectively throughout Mosquito Lake and its tributaries. Lesser numbers of steelhead fry (5,128 in 1982, 7,200 in 1983) were also released in this area. The lake is isolated from these anadromous species by a large falls on Pallant Creek. Prior to fry introductions, this habitat was utilized primarily by resident populations of cutthroat trout and lesser numbers of Dolly Varden char and kokanee.

The stocking enhancement program was implemented to establish adult runs prior to removal of the falls, thus al-

lowing for natural colonization of anadromous species into the previously inaccessible area.

The 1983 study program was initiated to assess possible impacts of coho and steelhead fry releases on resident cutthroat juveniles.

Data on juvenile fish distribution and densities in lake tributaries were obtained by electrofishing, fry traps, and angling throughout the year. Study streams were stocked with varying coho fry densities and their effects on the existing cutthroats were assessed.

Preliminary results indicate that cutthroat young of the year inhabit primarily shallow riffle areas of small tributary streams. These riffle habitats lacked coho fry. Cutthroat fry parr (1, 2, 3-year-olds) however, did co-inhabit pools with coho. Positive correlations were found between the size and densities of cutthroat parr and pool depth, as was the case with coho fry. In pools of tributary streams where coho fry had been released for three consecutive years, cutthroat parr densities were less than 30 percent of those areas not stocked with coho fry. Coho fry densities in streams which were naturally seeded (i.e., below falls), extensively stocked for 3 years, or selectively stocked at 1 and 5 per m^2, all equilibrated to an average density of about 1 fry per m^2 measured during low summer flows.

It appears that interactions between cutthroat and coho juveniles in Mosquito Lake tributaries take place in pools between cutthroat parr and coho fry, resulting in the displacement of cutthroat parr.

Mamin River Salmonid Study

The study of the distribution and biology of juvenile salmonids in the mainstem and tributaries of the Mamin River, a joint project between the Port Clements Rod and Gun Club and the Fish and Wildlife Branch is funded by the New Economic Expansion Program.

The Mamin River is a small stream (10-20 m width) flowing north into Juskatla Inlet on Graham Island.

A number of Queen Charlotte Island streams have received considerable coho fry introduction through the public participation projects of SEP. An egg incubation facility was constructed by the Port Clements Rod and Gun Club in an effort to increase coho stocks. Resultant fry were released at specific densities into several ponds and tributaries of the Mamin River. Since the fate of fry once released is frequently not assessed, a sampling program was initiated on the Mamin River to document the distribution, growth rates and possible interactions of juvenile salmonid species in this stream system.

Juvenile salmonids were captured throughout the watershed. All coho enhanced sites were sampled prior to fry release, and 2,000 fry were marked. Sampling started in early spring and continued throughout the summer and fall of 1983 and early spring of 1984. Fish were measured, weighed and identified by species. Habitat was also inventoried in association with fish capture sites.

In the mainstem Mamin River, the most common juvenile salmonid was steelhead, followed by lesser populations of coho salmon and Dolly Varden char. Densities of all three species was greatest in pools. Riffles generally contained few fish. No juvenile cutthroat trout were encountered in the mainstem, although the adults of this species were often found there.

The situation was vastly different in the smaller tributaries. No juvenile steelhead were captured in any of the tributary sites, despite extensive sampling. The dominant species in these areas were juvenile coho salmon and Dolly Varden char, with lesser numbers of cutthroat trout. Cutthroat fry and parr abundance was greatest in small low-gradient tributary stream sections with abundant cover.

Growth rates of released coho fry was greatest in pond habitats stocked

at low densities.

Mamin River Steelhead

This study of the life history characteristics and population estimate of Mamin River steelhead is a cooperative project between the Port Clements Rod and Gun Club and the Fish and Wildlife Branch.

Many anglers believe that the Queen Charlotte Islands have an abundance of wild steelhead in its streams. Due in part to high angler activity in other areas of the province, both nonresident and local sport fishing effort has increased dramatically on these islands over the past two decades. Although steelhead and angler-use studies have been conducted in some areas of the northwest, this information has seldom been obtained for a small less-fished coastal stream.

Since almost all Queen Charlotte Island streams are brown in colour, making snorkel observations impossible, a mark and recapture study was undertaken to determine life history characteristics and population abundance of Mamin River steelhead.

Steelhead were angled and tagged with colored spaghetti tags during the 1983-84 winter season. Scales were removed for age determination. Lengths, and in some cases weight, were also recorded. Instream movements and population abundance were derived from repeat captures.

All data have not been collated therefore results are inconclusive. Indications are that the steelhead population of the Mamin River is small, probably less than 200 fish. Steelhead enter the Mamin River from fall to late spring. Life history characteristics obtained from scale interpretations will be available in a forthcoming report.

Deena Creek Steelhead

The life history characteristics and population abundance of Deena Creek steelhead are being studied in a cooperative project of the Queen Charlotte Islands Chapter of the B.C. Steelhead Society and the Fish and Wildlife Branch.

Deena Creek flows north into Skidegate Inlet from the eastern slopes of Moresby Island.

Central to the development of steelhead management strategies is a thorough knowledge of population abundance and life history characteristics of this species on a stream-specific basis. A steelhead mark and recapture project was initiated through the local steelhead society in order to obtain some of this pertinent information.

Steelhead were captured by angling and seining, then marked with colored spaghetti tags and released at the capture site. Scale samples were taken, sex noted and lengths measured. Casual observations and snorkel diving surveys by steelhead society members frequently accompanied angling excursions.

Generally clear water conditions during the angling season allowed for reasonable close observation of tagged versus untagged fish. Population estimate results were variable and ranged from 598 to 1,311 adults (estimates include 1,311, 983, 648 and 598 fish). The lower estimate likely approximates reality more closely. Comparing observed tagged to untagged fish at the end of the season estimated 585 fish. Life history characteristics are as yet not known, but will become available after scales have been interpreted.

Yakoun River Steelhead

This study of the life history characteristics and population estimate of Yakoun River steelhead is a cooperative project of the Port Clements Rod and Gun Club and the Fish and Wildlife Branch.

The Yakoun River flows north into Masset Inlet near Port Clements on Graham Island.

It is the largest and most intensely fished steelhead stream on the Queen Charlotte Islands. Annual angling ef-

fort has more than tripled (almost 2,000 angler days in 1982) during the past fifteen years. This increased angler activity by both local and off-Island anglers created the necessity for better life history and population abundance information on Yakoun River steelhead.

Steelhead were caught by angling and tagged with colored spaghetti tags during the 1981-82 and 1982-83 winter seasons. Scales were removed for age determination; lengths and in some cases weight were also recorded. Migration patterns and population abundance data were obtained through repeat captures.

Yakoun steelhead enter the river from late fall to early spring, and once in the river, migrate very little. Average migration rates of repeat captures was 0.11 km/day, with some fish spending from one to five months in the original capture area. Population abundance varied dramatically between the two project years. In the 1981-82 season an estimated 800 steelhead were present, while during the winter of 1982 to 1983, over 2,000 fish were estimated in the Yakoun River. Scale interpretations indicated 90 percent of fish had spent three or more years in fresh water prior to a three year (73 percent) ocean residency.

Contact: Dionys de Leeuw, Fisheries Biologist, Fish and Wildlife Branch, Queen Charlotte City.

Job Creation Projects

Copper River Sockeye

The purpose of this project was to assess the sockeye run in the Copper River on Moresby Island. The run is the target of the Skidegate Band's food fishery and is currently being supported by a Band enhancement program.

The assessment was accomplished using a downstream smolt trap from which the fry and smolts were counted and measured twice daily, and a counting plate which enabled the four-person crew to count adults as they moved upstream. In addition, flows and temperatures were recorded for the Copper River.

It is anticipated that this program will be conducted annually when funding is available. This will enable effective enhancement and management of this fishery.

Coho Transplants

The purpose of this project was to study survival and growth rates of transplanted coho fry in ponds and streams in the Port Clements area. Five employees released 20,000 coho fry, installed fry traps, and monitored the effects of the introduced coho on the native coho.

Coho/Trout Interaction

Eight project employees surveyed several small streams near Sandspit to study the interaction of hatchery coho with existing stocks of trout.

King Creek Hatchery Construction

A longhouse-style hatchery building was constructed at the King Creek hatchery on the Yakoun River. The seven-person crew milled the timbers for the building and completed the basic structure. Insulation, interior partitions, a concrete floor and other finishing work was completed by the Masset Indian Band which operates the facility.

The building will be used to house incubation, rearing and adult holding facilities for chinook and coho salmon. As well, there is space for a workshop, office and storage.

Yakoun River Project

This project, sponsored by the Masset Band Council, involved a number of tasks on the Yakoun River. The four-man crew constructed trails to provide access to brood stock fishery sites. They trapped salmon fry to determine distribution and abundance within the Yakoun system and the relative number of hatchery and natural fish. The crew also helped in completing the interior of the new hatchery building at King Creek.

Access Trails

A nine-person crew sponsored by the Masset Band Council cut access trails along streams in the Yakoun River area to enable more accurate enumeration of spawning salmon. Maps were drawn of the area.

Juvenile Salmonid Study

This project recorded the timing and abundance of juvenile salmonids migrating seaward into Dixon Entrance. Seven workers caught fish at a point where they enter the ocean from Masset Inlet. The fish were identified as to species and examined for tags. Some fish were retained for dietary studies, aging tests, and weight and length measurements.

Contact: Colin Masson, Project Coordinator, Special Projects Division.

QUEEN CHARLOTTE ISLANDS PUBLIC PARTICIPATION PROJECTS

Location	Name of Group	No. of People Involved in 1983	No. of Years Group Involved In SEP	Type of Project	Species	Juveniles Released	% Survival	Expected Adult Production from 1983 Releases
Charley Hardy Cr.	UFAWU Local 28	2	2	incubation	chum	3,700	25	30
Powrivoo River	Frank Beban Logging	10	4	incubation	chum	20,000	80	160
Sewell Inlet	Western Forest Products	30	3	incubation	pink	10,000	71	250
					chum	75,000	60	600
					coho	15,000	65	180
Fairfax Creek	Tasu School	25	5	incubation in school	coho	190	95	2
Fairfax Creek	Tasu Lions Club	6	6	incubation	coho	22,500	94	270
Gore Brook	Gore Brook Group	5	5	incubation	coho	19,400	65	232
Charlie Hardy Cr.	Queen Charlotte City School	50	2	incubation in school	coho	190	95	2
One Mile Creek	Port Clements Elementary School	60	2	incubation in school, rearing	coho	120	60	1
Deep Creek	Tahayghen Elementary School	25	4	incubation in school	coho	25	8	0
Nadu Creek	Northern Trollers Assn.	6	5	incubation, counting fence	coho	15,000	45	180
Deep Creek	Northern Trollers Assn.	3	3	incubation, fishway	coho	3,000	60	36
Wylie Creek	G.M. Dawson School	10	4	counting fence	coho	—	—	—
					chum	—	—	—

Contact: Tom Rutherford, SEP Community Advisor.

QUEEN CHARLOTTE ISLANDS PUBLIC PARTICIPATION PROJECTS
(cont'd)

Location	Name of Group	No. of People Involved in 1983	No. of Years Group Involved In SEP	Type of Project	Species	Juveniles Released	% Survival	Expected Adult Production from 1983 Releases
Memin River	Port Clements Rod & Gun	10	2	incubation	coho	24,000	83	288
Yakoun River	Port Clements Rod & Gun	6	2	tagging	steelhead	—	--	—
Hearns/Sachs Cr.	Fred Hawkshaw	6	1	incubation	coho	No eggs taken in 1982.		
					pink	No eggs taken in 1982.		
Sachs Creek	A.L. Mathers School	25	1	incubation in school	coho	No eggs taken in 1982.		
Lawn Creek	Neil Davies	4	1	reconnaissance, construction	coho	No eggs taken in 1982.		
Pallant Creek	QCI Steelhead Society	10	1	tagging	steelhead	—	--	—
Jervis Creek	Jervis Crk. Residents	6	1	incubation	chum	No eggs taken in 1982.		

Contact: Tom Rutherford, SEP Community Advisor.

Table 31

Queen Charlotte Islands SEP Facilities*: Juvenile Releases 1983

Species	Brood	Group	Total Released	% Marked	% Survival	Average Size(g)
Pallant Creek Hatchery						
Chum	1982	Pallant	3,847,537	4	N/A	.55-1.7
Coho	1982	Pallant	447,973	25	N/A	2.9-5.2
Steelhead	1983	Pallant	15,458	0	N/A	1.49
Mathers Creek Pilot Hatchery						
Chum	1982	Mathers	267,500	0	N/A	1.10
Coho	1982	Mathers	62,016	0	N/A	1.80
Skidegate Community Development Project						
Coho	1982	Slarkedus	1,000	0	5	3.0
Masset Community Development Project						
Chinook	1982	Yakoun	212,000	18	69	3-5
Coho	1982	Wilson	26,000	0	65	5
Coho	1982	King	13,000	0	43	5
Coho	1982	Gold	7,000	0	14	5
Sockeye	1982	Gold	13,000	0	24	5

*Includes facilities constructed prior to SEP.
N/A means "not available."

Table 32

Queen Charlotte Islands SEP Facilities*: Status at December 1983

Species	Stock	Brood	Stage	No. on Hand	Expected Release Date	Number	Site
Pallant Creek Hatchery							
Chum	Pallant	83	egg	8,000,000	N/A	N/A	Dear Bay
Coho	Pallant	83	egg	300,000	N/A	N/A	Pallant
Pink	Pallant	83	egg	495,000	N/A	N/A	N/A
Mathers Creek Pilot Hatchery							
Chum	Mathers	83	egg	700,000	N/A	N/A	Mathers
Skidegate Community Development Project							
Sockeye	Copper	83		17,500	N/A	N/A	Skidegate
Coho	Slarkedus	83		18,000	N/A	N/A	Slarkedus
Masset Community Development Project							
Chinook	Yakoun	83	alevin	89,000	June 1984	85,000	Yakoun
Coho	King	83	egg	66,000	July 1984	60,000	King
Coho	Wilson	83	egg	3,000	July 1984	2,500	Wilson
Coho	Gold	83	egg	68,000	July 1984	63,000	Gold
Sockeye	Gold	83	alevin	13,000	April 1984	12,000	Gold

*Includes facilities constructed prior to SEP.
N/A means "not available."

Table 33

Queen Charlotte Islands SEP Facilities*: Escapement to Facility 1983

Species	Escapement to Facility	Spawned for Hatchery Stock male	Spawned for Hatchery Stock female	% Marked male and female
Pallant Creek Hatchery				
Chum	26,750	1,650	3,736	2.07
Coho	3,650	200	146	44.30
Pink	7,650	250	369	N/A
Mathers Creek Pilot Hatchery				
Chum	2,500	242	348	14.4
Coho	3,700	0	0	N/A
Pink	1,100	0	0	N/A

*Includes facilities constructed prior to SEP.
N/A means "not available."

Table 34

Queen Charlotte Islands SEP Facilities*: Adult Production

Species	Expected Production from 1983 Releases: Total Adult Production	Years of Return	Contribution to Fisheries	At Full Production: Total Adult Production	Contribution to Fisheries
Skidegate Community Development Project					
Coho	14	1984-1986	7	N/A	N/A
Masset Community Development Project					
Chinook	6,360	1985-1988	5,100	N/A	N/A
Coho	620	1984-1986	350	N/A	N/A

Pallant Creek Hatchery
Not available at time of printing.

Mathers Creek Pilot Hatchery
Not available at time of printing.

*Includes facilities constructed prior to SEP.
N/A means "not available."

North Coast

Brood stock is collected for the Kispiox Band project which enhances coho and chinook stocks.

North Coast

Kitsumkalum Community Development Project

The Kitsumkalum Band, located near Terrace, is evaluating opportunities for enhancement in the Terrace area. The study is being coordinated through a contract with SEP's Community Economic Development Program (CEDP) and is nearing completion. It is anticipated that, based on information available from that report, a facility will be started next year.

A new trainee has been hired through the Local Employment Assistance Program (LEAP) to assist the project manager. Both the project manager and the trainee have been attending courses on various aspects of fish culture.

Contact: Bruce Wright, Project Coordinator, Special Projects Division.

Kitsumkalum Pilot Hatchery

This was the last year of operation for this hatchery located on Dry Creek, 60 km north of Terrace on the Kitsumkalum River watershed. It has operated since 1980. Incubation (Heath trays) and rearing (Capilano troughs) facilities for 200,000 chinook fry were in place. In 1983, the project was handled by Kitimat hatchery staff.

Approximately 75,000 3-gram chinook smolts were reared and released into the Kitsumkalum River and 90,000 into the Cedar River.

In an attempt to achieve better growth of the chinook fry, water was recycled through industrial-type electric water heaters. This process was moderately successful, although diesel fuel costs (to provide electricity) at the site proved to be prohibitive.

Kitsumkalum River chinook enhancement will be continued by the Terrace Kitsumkalum Enhancement Society.

Contact: Dave McNeil, Stock Enhancement Officer, Enhancement Operations.

Terrace Kitsumkalum Salmonid Enhancement Society

This project was established, utilizing funding from the Special Employment Initiatives Program, to allow a community group to become part of the Community Economic Development Program (CEDP). The goal was to have a fully developed project which would meet community aspirations and contribute significantly to salmon enhancement.

The Society has completed a basic hatchery and is now rearing about 100,000 chinook salmon fry. The work doné includes: site preparation, installation of two 20 cm water supply pipelines, construction of a building for incubation, rearing, storage and office functions, construction of an aeration tower, plumbing and digging of a rearing channel. The Society has also undertaken stream improvement work in the Terrace area.

Two water supplies, one groundwater and one surface water, will enable the Society to rear up to 500,000 chinook salmon from various Terrace area streams.

Four person-years of employment resulted from this contract and two other job creation programs provided additional opportunities.

Contact: Bruce Wright, Project Coordinator, Special Projects Division.

Kispiox Band Project

The Kispiox project, located on the Kispiox Reservation at the confluence of the Skeena and Kispiox Rivers, is designed to increase the chinook stock, which is presently in severely depressed state, and the coho stock of the Kispiox River. Steelhead production may be incorporated into future operations.

In 1983, the new Kispiox hatchery was completed and an opening was held in August. This facility consists of a log-house style hatchery building 25 m x 16 m; three water sources including a 30 cm diameter well with a dual electric/diesel pumping system, a 15 cm well with an electric pump and access to the village water supply (gravity fed); and an aeration tower. Sixteen half-stack Heath trays provide an incubation capacity of approximately 800,000 eggs. The sixteen Capilano troughs allow for a flexible rearing program including the present strategy of releasing fry at a variety of sizes and times to determine the optimal long-term plan. In addition to regular CEDP funding, the project received monies and help through several job creation programs.

The hatchery was completed in time for collection of 185,000 chinook eggs and 105,000 coho eggs. Incubation proceeded well until a disastrous pump failure occurred in early December, not only shutting off the water supply but wiping out the backup system. The failure resulted in almost complete mortalities to the chinook (4,000 survived and have since grown well), but the coho were unaffected and maintained high survivals. Since the pumping system breakdown, further backup systems and improvements have been made, making the facility technically as risk-free as possible.

Valuable information on growth rates will be gained from rearing the 1983 chinook (4,000) through 1984 for release in April 1985. The 1983 coho will be reared and released in three groups; the first (approximately 70,000) for release in late October 1984 at approximately 8 grams, the second and third for release in May 1985 and June 1985 at 25 and 30 grams respectively. All groups of released fish will be differentially coded-wire tagged to provide information on survival rates and contribution to the fishery.

Plans for 1984 include the installation of an improved aeration tower, the operation of a downstream fry trap to indicate peak outmigration times for both coho and chinook, collection and incubation of approximately 150,000 - 200,000 chinook eggs and 90,000 coho eggs, and continued upgrading of the facility.

This project provides full-time employment for three staff and three more person-years of part-time employment.

The hatchery is also utilized as a training facility by the CEDP training program as a classroom.

Contact: Colin Masson, Project Coordinator, Special Projects Division.

Babine Facilities

The Babine Lake spawning channels and river flow control facilities began as the Babine Lake Development Project in 1962. Earlier studies had indicated that the main basin of the lake could rear more sockeye fry than the rivers and streams flowing into the lake could produce. The project was designed to produce an additional 100 million fry to rear in the lake, thus increasing the size of the Skeena River sockeye run. At full capacity, the channels have exceeded the fry production targets, averaging 120 million fry annually.

Fry production during 1983 from the Fulton River and Pinkut Creek facilities totalled 212 million. Adult escapement, including jacks, totalled approximately 550,000, and was similar to that observed in 1982.

Fulton River

Fry production from the Fulton River system in 1983 was 106.7 million from a 1982 escapement of 400,000 adults. Overall egg-to-fry survivals were lower than average. A very small percentage of the early fry migrants from channel 2 exhibited symptoms of IHN, a viral infection. This may have been linked to a recurrence of the algal problem. Adult escapement to the facilities during the 1983 fall program totalled 394,000 adults, and both channels were filled to capacity.

In the spring of 1982, an algal growth formed a mat-like cover over most of channel 2, approximately 15 m wide and 5 km long. The growth began as the fry emerged from the gravel and is believed to have lowered the egg-to-fry survival in the channel by trapping fry in the gravel and reducing the intragravel water flow. Consultants were contracted to study the growth and identified it as a composite algal-fungus growth, consisting mostly of diatoms.

In early 1983, before the fry migration began, a method was developed to physically remove most of the algal growth. In addition, those factors which could cause or affect the growth were studied. Spring sunshine hours were found to be higher than in previous years and were thought to be a possible cause of the algal growth.

The algal mat reappeared in channel 2 in 1983 and was continually removed throughout the fry migration. However, egg-to-fry survival remained similar to that of the previous year. In addition, IHN was observed in approximately 5 percent of the first 0.5 percent of the fry to migrate from channel 2. This is an insignificant number of fry, but the effects of IHN on fry in the gravel are unknown. As well, for the first time, small amounts of the problem algae were observed in channel 1.

In the fall of 1983, a program was initiated to further examine the problem. A water quality and benthic invertebrate sampling program was started, as well as a series of studies to measure algal growth rates and invertebrate grazing rates. Data from these studies are currently being analyzed. It is hoped that an operational strategy to eliminate or reduce the problem will be developed within a year.

Pinkut Creek

Fry production from the Pinkut Creek facilities totalled 105.3 million in 1983 from an escapement of 150,000 adults in 1982. Overall egg-to-fry survival was excellent. Adult escapement to the system during the fall of 1983, including jacks, totalled 157,000 fish. Both the channel and river were filled to capacity. There were not enough surplus fish to warrant an airlift above the falls.

Contact: Kevin Loftus, Operations Support Biologist; Colin Harrison, Stock Enhancement Officer, Enhancement Operations.

Fort Babine Community Development Project

This CEDP developmental project entered its second year with the hiring of a new project manager. Fort Babine is located at the northern end of Babine Lake at its outlet to upper Babine River. The objectives of this developmental project are to train individuals in appropriate biotechnical and managerial skills and abilities for operating an enhancement project, to identify a feasible enhancement opportunity and to develop a pilot scale project.

An experimental instream incubator was designed for this project and was subsequently constructed and installed. Approximately 72,000 Babine River coho eggs were collected and planted in the vertical trays of this incubator in November and have experienced no problems to date.

An experimental floating rearing trough was also designed for use in

Babine River by this project. This floating trough successfully doubled as an adult holding facility and is anticipated to be quite satisfactory for rearing fry.

Various job creation contracts have contributed to a viable project at Fort Babine. A Canada Employment and Immigration Commission (CEIC) job creation contract provided labor to construct an 5.5 m river boat for future fisheries work by the community, in addition to providing manpower and materials to assist in the construction of the incubator and rearing trough. A General Industrial Training contract between the community and CEIC provided funds to support three trainees in a program to develop biological and technical skills for fisheries work.

A contract with CEDP is planned for 1984/85 to continue to fund the project manager and the basic operating costs of a pilot chinook enhancement project. This project will also include the incubation and rearing of the 70,000+ coho (1983 brood) until their release in April 1985, and for the collection of 50,000 - 100,000 chinook eggs in the fall of 1984. Supplementary funding is anticipated to again be available through CEIC job creation programs.

Contact: Colin Masson, Project Coordinator, Special Projects Division.

Kincolith Band Project

The Kincolith Indian Band operates a small chinook and coho hatchery on the Kincolith River near the mouth of the Nass River. Two members of the band are employed on a full-time basis and up to eight are employed on a part-time basis. A job creation program is currently employing four additional people to undertake improvements to the facility.

In 1983, 118,000 coho fry were released in the upper reaches of the Kincolith River. The new river intake water supply was successful. At the present time 150,000 coho eggs and 85,000 chinook eggs are being incubated at the hatchery. In 1984, more emphasis will be placed on chinook salmon, and a program of bioreconnaissance to explore satelliting opportunities will be undertaken.

Major improvements at the hatchery, in addition to the water supply, included construction of a building to house the Capilano troughs and construction of adult holding facilities.

Contact: Bruce Wright, Project Coordinator, Special Projects Division.

Morice River Reconnaissance

The reconnaissance data from 1978/80; in-house studies of juvenile migration and rearing; coded-wire tagging of pen-reared fry, and adult spawning were compiled into a formal report in 1983.

Contact: Bruce Shepherd, New Projects Coordinator;
Gordon Bérézay, Operations Support Biologist, Enhancement Operations.

Tuya River Reconnaissance

A $20,000 contract was established in fall, 1983, with the Northwest Enhancement Society to conduct a winter reconnaissance program investigating open water areas on the Stikine, Tuya, and Tachilta River systems. The contractor located five open water sites, three of which appear to have enhancement potential due to the flow characteristics. Thermographs were installed at the outlet of Tahltan Lake, Tuya Lake and in the upper Tuya River. Physical characteristics, such as ice thickness, subsurface flow, snowpack and air temperatures were recorded. A report on the reconnaissance program is available. The data point to a follow-up study to evaluate water quality, develop a preliminary biological plan and test a small pilot incubation facility.

Contact: Gary Logan, Unit Head, Small Projects Unit, Special Projects Division.

Nass River Reconnaissance

The lower Nass River system was surveyed to obtain additional information on enhancement opportunities on the Tseax and Seaskinnish River systems.

Contact: George Nielsen, Senior Project Engineer, Engineering Division.

Whitehorse Rapids Mitigation Facility

This facility was built by the Northern Canada Power Commission (NCPC), with advice from the SEP Enhancement Operations Group. Although it was essentially completed late in 1982, it was not operated in 1983 due to funding difficulties experienced by NCPC. Funding of the operation remains uncertain. If funding is provided, SEP Enhancement Operations has agreed to supervise the operation of this facility because it will provide valuable experience with northern fish culture. To this end, efforts were being made by SEP in late 1983 to undertake cold-weather testing of this facility early in 1984.

Contact: Bruce Shepherd, New Projects Coordinator, Enhancement Operations.

Provincial Status Report

Skeena River Steelhead Smolt Capacity Modelling

Early in 1982, fisheries management staff of the Fish and Wildlife Branch launched a program to bring together all information regarding the status of Skeena River summer-run steelhead stocks.

The overall objective was to relate, on a stock specific basis, present steelhead population size to historic population size, and to the streams' productive (smolt) capacity. Three general tasks were set:

- presentation of steelhead population status
- reconstruction of historic stock size
- assessment of stream smolt production capacity.

Initial modelling of steelhead smolt yield was directed at application of the Keogh River smolt model to available habitat data. A second attempt at modelling incorporated the Keogh model with juvenile steelhead population density data collected by FHIS in streams throughout the Skeena. Smolt capacity estimates ranged from 282,000 to 517,000 and were considered to be in the ballpark when compared to present and historic adult population predictions.

Significant gaps in juvenile steelhead population data were identified in the course of the modelling exercise. These included the degree of utilization by juvenile steelhead of mainstem habitats (e.g., Skeena, Bulkley, Morice) and juvenile steelhead population density in a range of stream types and sizes throughout the Skeena.

The objectives of the Skeena steelhead modelling program in 1983/84 were therefore to collect data to answer the question of mainstem utilization and to fill the gaps in the data base concerning stream type.

Fiscal year activities included collection of fish population and stream habitat data at selected sites throughout the Skeena system. Sampling was aimed at large mainstem areas and tributaries which were suspected to be operating at carrying capacity.

Electroshocking was conducted at 17 sites, from the Skeena below Terrace upstream to the Morice River. Crude fish population estimates and usable area estimates were conducted. Rainbow parr density ranged from 4/km in the Morice River to 200/km in the lower Bulkley River. Through the Bulkley/Morice system there was decreasing density with upstream distance. A

similar pattern was found for chinook fry, ranging from 10/km in the Morice River to 522/km in the lower Skeena.

Tributary sampling was conducted at nine sites in areas not previously sampled. Population estimates have been calculated and added to the data file.

Further steelhead smolt modelling will be conducted in 1984/85, with an expanded focus to cover steelhead throughout B.C. This program will be a priority. Data collected in 1983/84 will provide important reference points.

In addition, analysis of Bulkley/ Morice and Kispiox River steelhead dynamics will be enhanced by these new data. These projects will be undertaken when time permits.

Contact: Dave Tredger, Fisheries Biologist, Fish and Wildlife Branch, Victoria.

Skeena River Steelhead

Most of this work focuses on tributaries of the Skeena River that are major producers of summer-run steelhead. Systems that have been examined to date include the Bulkley River and its tributaries and the Kispiox, Kitsumkalum, Morice, Suskwa and Zymoetz (Copper) Rivers.

The primary focus of provincial SEP activity in the Skeena region has been Skeena River summer steelhead. Increased production of steelhead in the Skeena River is now based almost solely upon fry stocking above barriers or in underutilized habitat.

Skeena tributaries were surveyed to determine baseline biological data on juvenile steelhead densities and survival rates. Barren habitat was located in Harold-Price Creek (Suskwa River) and in the Morice and Zymoetz Rivers which are presently stocked annually or in alternate years with summer steelhead fry.

An integral part of the fry stocking project is the annual assessment of stocked systems to determine the survival of fry and parr. This assessment procedure determines the success of the fry plants and refines the target for fry stocking in following years.

In 1983, the juvenile assessment phase of the program was divided into two parts; the first of which was the annual monitoring of index sites throughout the Skeena drainage. These sites are sampled every year during specified times so that annual comparisons of juvenile densities and survivals can be made. The second part of the juvenile assessment was the sampling of new systems in the Skeena to investigate the feasibility of fry stocking in the future.

Based on data of similar work in previous years, the Morice River and Harold-Price Creek (Suskwa River) were stocked with steelhead fry. All planted fry were progeny of wild brood stock from the stocked systems.

Approximately 100,000 fry were liberated in underutilized areas of the upper Zymoetz in 1981 and again in 1983. Poststocking assessment indicated that the stocked juveniles (clipped) were doing well and should begin to return as adults in 1985.

A similar project in the Morice River system began in 1983 with 70,000 summer steelhead fry stocked above barriers and in underutilized areas.

The eventual target for the Harold-Price is 200,000 fry which should produce approximately 1,000 adults. The stocking of fry above the falls began with a pilot project in 1979 and was continued in 1980 and 1982. In 1984, 90,000 fry are slated for stocking as this project approaches its target. Once again, poststocking assessment of juveniles above the barrier indicated that planted fry were doing well.

This year, for the first time, data from the annual assessment of the index sites were used as a basis for management purposes as seen in regulation

changes. Poor smolt production resulting from floods was detected by the juvenile sampling, and catch limits on adults will be reduced to catch and release until runs recover.

Contact: Mike Lough, Fisheries Biologist, Fish and Wildlife Branch, Smithers.

Skeena River System Steelhead Fry Recruitment Monitoring

Since 1980, an assessment of steelhead carrying capacity in selected Skeena River streams (Kispiox, Morice and upper Bulkley River systems) has been conducted. One task in these assessments was to monitor annual steelhead fry recruitment at "index" sampling stations.

The goal of the fry monitoring program is to relate fry population levels to optimum levels as estimated in carrying capacity reports (available only for Kispiox at this time). Ultimately, fry populations will be related to estimates of adult run size for harvest predictive purposes.

Fry recruitment monitoring has been reported specific to individual system assessments (e.g., upper Bulkley, Morice and Kispiox).

Sampling was conducted in the Kispiox, Morice and upper Bulkley systems. Results from the upper Bulkley indicate a larger fry population than in either 1981 or 1982. Kispiox and Morice data have not been analyzed.

Contact: Dave Tredger, Fisheries Biologist, Fish and Wildlife Branch, Victoria.

Kitsumkalum River Fish Density

The Terrace-Kitsumkalum Salmonid Enhancement Society, under the direction of SEP's Public Involvement Program, is involved in a chinook and coho enhancement program. Currently, a hatchery facility is in operation on Deep Creek, a Kitsumkalum tributary. Concern with potential impacts of hatchery releases on juvenile steelhead rearing was voiced by Regional Fish and Wildlife staff. In an effort to document these concerns, a brief reconnaissance was conducted on August 29, 1983.

Impacts of hatchery introductions on current steelhead production in the study streams was discussed in terms of stream carrying capacity and present fish populations. Given current (1983) population levels, coho introductions were not recommended for Spring and Lean-To Creeks, while a limited release of 10,000 coho was suggested for Deep Creek.

A more detailed assessment of Kitsumkalum River tributaries is being planned.

Contact: Dave Tredger, Fisheries Biologist, Fish and Wildlife Branch, Victoria.

Bulkley River Steelhead

The Bulkley River provides one of the major steelhead fisheries in B.C. Recent radio-tagging studies throughout the Skeena River drainage indicate that Bulkley steelhead are heavily harvested in the salmon gillnet fishery at the mouth of the Skeena near Prince Rupert. It is anticipated that these commercial interceptions of steelhead may increase in future years as major salmon enhancement projects reach full production and the gillnet pressure increases.

In order to compensate with future steelhead enhancement, a detailed survey of steelhead in the Bulkley River was initiated in 1982.

The project in 1983 was a sequel to the 1982 creel survey. It was implemented to provide a second year of results upon which to base fisheries management decisions.

The objectives in 1983 were to:

- conduct a survey of steelhead anglers in the area between Smithers and Houston

- refine run timing by tagging as many steelhead as possible
- further refine life history data.

The survey produced considerable information about anglers fishing the Bulkley River. A total of 2,676 angler-days was reported in the area between Smithers and Houston. Local fishermen accounted for the majority of the angling effort in the portion of the Bulkley-Morice system surveyed during the 1983 steelhead fishery.

B.C. residents, other than locals, were responsible for 22.3 percent of the angler-days reported and accounted for 33.8 percent of the total number of anglers checked.

Anglers from outside B.C. made up 17.0 percent of the total number of anglers; 13.4 percent (64 anglers) were not residents of Canada and 3.6 percent (17 anglers) were Canadian residents not living in B.C. These anglers accounted for 10.6 percent and 2.5 percent respectively of the total reported angler-days.

The area between Chicken Creek and Telkwa accounted for 34.9 percent (933 angler-days) of the 2,676 angler-days reported. The second most popular area was between Barrett and Three Mile on the Morice, where 31.7 percent of the angler effort was directed.

Locals represented the vast majority of anglers checked between Chicken Creek and Telkwa (56.2%)and between Telkwa and Quick (56.1%). In other areas, B.C. residents accounted for most of the anglers (43.6% and 45.9% respectively) followed by locals (33.6% and 38.0% respectively).

The month of September accounted for 55.7 percent (1,490 angler-days) of the total effort during the creel census. October attracted 34.5 percent and November 9.8 percent of the total angler effort (the steelhead fishery ended on November 20 due to inclement weather).

Anglers caught a total of 877 steelhead in 2,676 angler-days for an overall success rate of 0.33 fish per day. Local anglers landed 466 steelhead (50.9 percent), but had the lowest rate of success at 0.25. Non-Canadian anglers accounted for only 21.0 percent of the catch but showed the highest success rate (0.65 fish per day). Resident (B.C.) anglers landed 223 steelhead (25.4 percent) while nonresident Canadians caught 24 (2.7 percent).

Overall, anglers killed only 19 percent of their catch. Nonresident Canadians killed 38 percent of the fish they landed, while non-Canadian anglers killed only 4 percent. Locals and residents killed 20 percent and 28 percent of their catch respectively.

During 1982 and 1983, 715 steelhead were tagged on the Bulkley-Morice system. To date, 67 recaptures have been reported.

Of the 317 steelhead tagged in 1982, there have been 29 recaptures to date. Of the 398 steelhead tagged in 1983, there have been 38 recaptures to date.

Scale samples were collected from 245 steelhead during the 1983 creel census, of which only 10 were unsuitable for use in total age determination. Eight age groups were identified, with the most common being 3.1+ (57.9 percent). The second most common age group was 3.2+ (23.8 percent), followed by 4.1+ (10.6 percent). The 3.1+ fish were male dominant (60.3 percent), while the 3.2+ steelhead were mostly female (73.2 percent). Repeat spawners, most of which were females, accounted for only 3.4 percent of the steelhead sampled in 1983.

Contact: Mike Lough, Fisheries Biologist, Fish and Wildlife Branch, Smithers.

Kitimat River Steelhead

The Kitimat River is located approximately 30 km due south of Terrace and flows to bisect the city of Kitimat near the head of Douglas Channel.

Historically, the Kitimat River supported an above average winter steelhead run which, over the years, dwindled due to the combined effects of habitat degradation and overfishing. With construction of a new SEP hatchery facility in Kitimat, the opportunity arose to bolster Kitimat steelhead stocks; basically to align them with angler demand and perhaps to reduce pressure on other nearby steelhead stocks. Beginning in 1983, 25,000 steelhead were to be reared to smolt size annually and then released in predetermined sites on the river. However, it became necessary to review plans for Kitimat when it became apparent that the new hatchery facility would not be ready in time for the 1983 brood year. Therefore, the 1983 project was terminated. In 1984 the project will proceed as described above.

Once the Kitimat facility comes on line, creel surveys will be performed from time to time to determine what portion of the anglers' catch are fish of hatchery origin, and regulations will be adjusted accordingly.

Contact: Bill Chudyk, Fisheries Biologist, Fish and Wildlife Branch, Smithers.

Kitsumkalum River Steelhead Investigations

The Kitsumkalum River flows south into the Skeena River near Terrace from Kalum Lake. Kalum Lake is 12 km long, and the river is 30 km in length.

The Kitsumkalum River provides a combination of scenery and year-round angling that has made it a major recreation area for local as well as nonresident sportsmen. It supports major sport fisheries for salmon, steelhead and resident rainbow and cutthroat trout. Increased angling pressure combined with intensive logging in the upper watershed during recent years prompted the B.C. Fish and Wildlife Branch to conduct a preliminary investigation of Kitsumkalum River steelhead trout. The objectives of the study were to better understand the sport fishery, the run timing and movements of steelhead within the sport fishery, as well as their wintering and spawning behavior. In addition, baseline biological data were required along with options for management and enhancement.

Data from the 1981 study were analyzed and reported in 1983. Twenty-two steelhead were radio-tagged, and an additional 45 steelhead were spaghetti-tagged so that their behavior could be better understood. Movements of radio-tagged fish were monitored until spawning time in the spring, and records were kept of tagged fish recaptured in the fishery. Readable scales from 69 steelhead were analyzed for age and growth information.

An examination of the sport fishery indicates that although total catch has increased in recent years, the kill has remained fairly stable due to an increasing incidence of catch and release.

Tagging data indicate that the Kitsumkalum has three main steelhead runs: late summer, late fall, and spring; all of which spawn during May. The lakes of the system were heavily utilized by wintering steelhead. Several tributary streams and side channels were identified as valuable spawning and rearing areas.

Aspects of life history are described from the data derived from analysis of scales. Most juveniles spent three years in fresh water and the remainder spent four years before smolting. Returning steelhead spent one to three years in the ocean before spawning.

Some of the management and enhancement options include angling restrictions in areas of high summer steelhead density, headwater fry stocking above barriers, and rehabilitation of side channels that were closed years ago to aid in log drives.

Contact: Mike Lough, Fisheries Biologist, Fish and Wildlife Branch, Smithers.

Lakelse Steelhead

The Lakelse River flows from Lakelse Lake north into the Skeena River near Terrace.

The Lakelse is one of the most productive systems in the Skeena drainage. Ideal habitat combined with warm, clear water give this river its productive capacity. It supports major sport fisheries for salmon, steelhead and resident cutthroat trout. The main part of the fishery is for steelhead, but management has been difficult because there are three separate steelhead stocks within the Lakelse: summer, fall and spring runs. Lack of hard data on run timing and behavior of the various stocks in relation to the sport fishery hampers regulation design and management.

In a joint project with the Terrace chapter of the Steelhead Society of B.C., the Fish and Wildlife Branch carried out a two-year study of steelhead movements within the Lakelse Lake drainage.

The work done in 1983 was basically a repeat of the 1982 program. Various portions of the steelhead run were tagged with radio transmitters to monitor their behavior up to and including spawning. In addition, steelhead were tagged with spaghetti tags, a different color for each part of the run so that they could be identified on snorkel surveys in the spring. Scale samples were collected from all fish tagged to bolster age and growth data for Lakelse steelhead.

Preliminary analysis of the results indicates that the three runs behave differently, and exhibit a spatial segregation within the Lakelse. The lake was heavily used by summer runs as overwintering habitat during icy conditions in the river. Some of these fish spawned above the lake and some dropped back down into the upper Lakelse River to spawn. The spring-run fish, on the other hand, stay almost entirely in the lower half of the river and do not utilize the upper half of the river or the lake.

Management implications of these results are fairly straightforward. In order to protect the heavily exploited summer and fall-run fish, the upper part of the river is only catch and release in the spring. A kill fishery is permitted on the lower river, where most fish are spring-run steelhead and subject to only light harvesting. Enhancement and regulations in the future will utilize this information to ensure that the summer and fall steelhead are not overharvested in the sport fishery, and that the fish have priority in any production projects.

Contact: Mike Lough, Fisheries Biologist, Fish and Wildlife Branch, Smithers.

Sustut River Reconnaissance

The Sustut River is located about 160 km north of Smithers and is a major tributary of the Skeena River. Tributaries of the Sustut include the Bear River, Asitka River and Johanson Creek.

The Sustut has long been known for its run of large steelhead trout. Angling pressure has been relatively light due to the remoteness of the system, although in the 1970s, construction of the British Columbia Railway and the associated airstrips created new access and hence increased angling pressure. Regulations banning angling in waters above the Bear-Sustut confluence were therefore instituted to protect this vulnerable stock.

An angling guide has operated on the river for 17 years; two others are starting operations in 1984.

Due to recent management and enforcement concerns, a reconnaissance survey was carried out to gather biological data for Sustut steelhead as well as to create a higher enforcement profile in the area.

Fish and Wildlife personnel made four trips to the Sustut during the peak of the steelhead fishery in September and October.

Overview flights were made to locate anglers, check guide camps and find concentrations of fish. Juveniles were sampled from the mainstem to obtain data on age, growth and densities. Scale samples were taken from 61 adult steelhead which were also tagged before their release.

Fifty-five steelhead were spaghetti-tagged to aid in identification of run timing in the commercial fishery at the mouth of the Skeena. Scale sample analysis indicated that only 32 percent of the steelhead juveniles spent three years in fresh water, while the remaining 68 percent spent four or five years in fresh water before smolting. Additional juvenile sampling will be continued next year to add to the preliminary data obtained in 1983.

Another objective, to create a higher profile for the Fish and Wildlife Branch, was achieved through checks of fifty-four anglers and hunters.

Contact: Mike Lough, Fisheries Biologist, Fish and Wildlife Branch, Smithers.

Kispiox River Steelhead

Assessment of the juvenile steelhead population of the Kispiox River system has been conducted for three consecutive years (1980 to 1982). Goals of the assessment program were to outline carrying capacity of the Kispiox system in terms of steelhead smolt yield and to recommend methods of steelhead enhancement applicable to the Kispiox.

Objectives of the annual sampling program were to conduct a biophysical assessment of the Kispiox system, to monitor steelhead fry recruitment levels, and to define optimum fry recruitment relative to fry to parr survival, and subsequent smolt yield. In 1983/84, a summary of the three years of assessment was prepared to meet the goals of the program.

a) Steelhead Fry Population Monitoring

At index sampling sites, mean steelhead fry density was greater in 1981 than 1980 (+0.88 fry/m) or 1982 (+1.29 fry/m). Weighted population estimates based on index site results indicate total fry populations of 526,000 in 1980, 646,000 in 1981 and 408,000 in 1982.

Attempts to relate fry population estimates to "reliable" escapement estimates (total run reconstruction) proved inconclusive. The highest fry population did correspond with the highest estimate of escapement [646,000 fry from 1980 escapement (1981 brood) of 1,175], but the smallest fry population related to theoretically moderate escapement (408,000 fry from 1981 escapement of 1,040). The moderate fry population related to the lowest estimated escapement (526,000 fry from 1979 escapement of 775).

b) Fry to Parr Translation and Survival Rates

Estimated steelhead parr population increased in the Kispiox system through all sampling years. Yearling population increased from 97,500 in 1980, to 123,000 in 1981, to 309,000 in 1982. The 2+ parr population increased from 25,000 in 1980, to 41,000 in 1981, to 81,000 in 1982.

Survival rates from fry to 1+ (for consecutive years) was 23 percent from 1980 to 1981, and 48 percent from 1981 to 1982 (average 35.5 percent). These values are considered high in terms of the 15 percent "standard" value. Yearling to 2+ survival rates were estimated at 43 percent and 66 percent (average 54.5 percent) for 1980 to 1981 and 1981 to 1982, respectively. These values are questionable due to difficulties in sampling older (i.e. 2+) parr.

c) Smolt Capacity

Theoretical smolt capacity was estimated by five methods, producing a variety of estimates. A reference value of 33,000 smolts was obtained by relating maximum historical adult run size (estimated) to expected smolt-to-adult survival. Other estimates are discussed.

Probable limiting stage in Kispiox smolt production was suggested as older (2+ to 3+) parr habitat. This was suggested by the size of actual yearling parr population in relation to the reference smolt yield.

d) Required Escapement

An estimate of the adult escapement required to assure maximum smolt production was 1,100 fish. This estimate was based on average survival estimates for juvenile steelhead. Environmental conditions play a significant role in annual survival. Escapement of this magnitude, if properly distributed, should produce maximum smolt yield annually. At saturation, a 12 percent smolt-to-adult returns a catch:escapement of 2.6:1 (i.e. 2,860 catch).

Contact: Dave Tredger, Fisheries Biologist, Fish and Wildlife Branch, Victoria.

Trout Creek Density Study

Trout Creek, a tributary to the Bulkley River, was considered as a potential site for headwater steelhead fry stocking. Currently, an impassable falls, 1 km from the Bulkley River, blocks access to approximately 13 km of stream habitat. Cutthroat trout comprise the resident fish population above the falls. A brief reconnaissance was conducted in August 1983 to document resident cutthroat trout population status, habitat capability, steelhead production capacity and potential fry stocking requirements.

Low sample density (due to limited access) produced major limitations in data, therefore, reliable standing crop and carrying capacity estimates were not possible. Roughly estimated steelhead fry stocking requirements ranged from 9,500 to 21,000. More intensive ground reconnaissance to determine habitat characteristics and current cutthroat populations was recommended. This will be conducted in 1984.

Contact: Dave Tredger, Fisheries Biologist, Fish and Wildlife Branch, Victoria.

Harold Price Creek Fry Stocking

Harold Price Creek is a tributary to the Suskwa River located 16 km east of New Hazelton.

The Suskwa River steelhead enhancement project was initiated in 1977. The project has involved modification of the Harold Price Creek barrier (falls) by blasting (1977 to 1979) and outplanting of steelhead fry into the upper Harold Price Creek system.

In August 1982, an assessment of upper Harold Price Creek was conducted to determine potential steelhead smolt production (estimated at 0.0087 smolts/m^2 or 6,000 smolts) and steelhead fry stocking requirements (estimated at 0.25 fry/m^2 or 170,000 fry). In September 1982, a release of 48,300 hatchery steelhead fry (0.41 fry/m^2) was conducted in portions of the upper Harold Price Creek system. An August 25, 1983 assessment was conducted to evaluate the 1982 fry release program in terms of translation to 1+ parr and to monitor wild steelhead recruitment above the Harold Price Creek falls.

Twenty-seven yearling (1+) rainbow, resulting from 1982 fry stocking, were captured in the sampling program. These fish had moved up to 8 km from release sites. Average sampled density was 0.064/m^2, slightly greater than the predicted average density of 0.0435/m^2. Suspected positive sampling bias suggests that the average density would approach the 0.0435/m^2 expected. Estimated survival from September 8, 1982 release to August 25, 1983 capture was 11 to 32 percent, with the most likely estimate being 22 percent. The fry release density of 0.41 fry/m^2 was suggested as greater than required to meet parr saturation goals.

No wild steelhead fry were captured above the falls, indicating a continued problem with fish access at the Harold Price Creek falls.

Fry colonization and assessment will continue as a regional program.

Contact: Dave Tredger, Fisheries Biologist, Fish and Wildlife Branch, Victoria.

Morice River Steelhead Assessment

Juvenile steelhead populations in the Morice River system have been studied since 1980. Sampling has been conducted over three consecutive years (1980, 1981 and 1982), concentrating on late summer (August) population estimates.

The original sampling in 1980 concentrated on Owen and Lamprey Creeks in an attempt to outline enhancement techniques applicable to these streams. Recommendations from the 1980 program included an expansion of sampling effort to include the entire Morice River system and to specifically put Owen and Lamprey Creek production into an overall system perspective. The sampling program was expanded to include the entire Morice system in 1981 and continued as index site sampling in 1982. In 1983/84, a summary of the three years of assessment results was prepared, with emphasis on annual variation in habitat characteristics and fish populations.

The results of three consecutive years (1980 to 1982) of juvenile steelhead population monitoring in the Morice River system were summarized in 1983/84.

Emphasis was placed on Owen and Lamprey Creeks, with lesser effort on other tributaries and mainstem areas. Estimated steelhead fry populations in Lamprey Creek ranged from 45,000 to 70,000. The one year-plus population ranged from 17,000 to 30,000, while the 2+ population ranged from 1,100 to 5,400. Three-year-old parr were found only in 1982. Estimated survival rates range from 25 to 68 percent for fry to 1+ and 6.6 to 18 percent for 1+ to 2+. Total steelhead biomass was relatively constant, ranging from 214 to 239 kg.

Estimates of Owen Creek steelhead population ranged from 38,000 to 100,000 fry, 19,000 to 31,000 yearlings and 3,000 to 6,300 two-year-olds. No 3+ parr were found. Survival rates ranged from 29.6 to 81 percent for fry to 1+, and 9.6 to 33.7 percent for 1+ to 2+ parr. Total biomass ranged from 287 to 581 kg. More limited results are presented for other tributaries and the mainstem. Very rough steelhead parr capacity estimates using a preliminary steelhead smolt model are presented. Headwater fry-stocking opportunities are briefly discussed.

No discussion of overall Morice River steelhead life history and smolt capacity was presented in 1983/84. Important data regarding steelhead parr densities in the mainstem Bulkley and Morice Rivers were collected during the 1983/84 Skeena electroshocking program. An overall perspective will be produced as time permits.

Contact: Dave Tredger, Fisheries Biologist, Fish and Wildlife Branch, Victoria.

Job Creation Projects

Skeena Estuary Studies

The purpose of this project was to document and map areas of the Skeena River estuary (near Prince Rupert) which are considered to be feeding grounds and producers of food for migrating and rearing salmonids. The five workers used beach seines and Gee traps at suitable sampling sites to aid them in their studies.

Such areas as gravel beds, sand shoals, bars and banks were investigated. Of particular interest were areas of proposed development and construction (CN Rail, Department of Highways, B.C. Hydro, port development, etc.)

Lower Skeena River Salmonid Habitat

This project examined the salmonid habitat on the lower Skeena River. The 15 workers enumerated salmonids using the estuary, and a research team reviewed technical and biological matters related to Skeena River development applications.

Kitsumkalum Biophysical Data

The main goal of this project was to

collect and tabulate biophysical data necessary to develop a hatchery for chinook and coho on the Kitsumkalum River. In addition to this task, the 13 workers removed stream obstructions and did other stream rehabilitation work. By the end of the project a hatchery site had been cleared. The Terrace-Kitsumkalum Salmonid Enhancement Society built and will operate the facility on a contract basis.

Kitsumkalum Hatchery Development

The six workers on this project helped finish and landscape the hatchery operated by the Terrace-Kitsumkalum Salmon Enhancement Society. They also helped develop a rearing channel.

Specific activities included:

- site cleanup and landscaping
- painting and panelling the inside of the hatchery
- constructing stairs and a fence
- installing siding on the building
- upgrading the rearing channel and constructing weirs
- enclosing the aeration tower.

Kispiox Hatchery Construction

Eight members of the Kispiox Band finished constructing a hatchery building and pumphouse at the confluence of the Skeena and Kispiox Rivers. The facility will be operated as a community economic development project and is designed to increase chinook and coho stocks in the Kispiox River.

Upper Kispiox River Salmonid Habitat

A five-person crew based in Hazelton enumerated fish from numerous lakes and streams in the area, and cleared obstructions which were blocking upstream migration of spawning salmonids.

Contact: Colin Masson, Project Coordinator, Special Projects Division.

Table 35

Public Participation Projects

NORTH COAST PUBLIC PARTICIPATION PROJECTS

Location	Name of Group	No. of People Involved in 1983	No. of Years Group Involved In SEP	Type of Project	Species	Juveniles Released	% Survival	Expected Adult Production from 1983 Releases
Kloiya Creek	Northern Trollers Assn.	15	5	incubation	chinook	43,000	96	1,000
Diana Creek	Northern Trollers Assn.	12	5	incubation	coho	9,000	36	135
L alse River	Uplands Elementary School	22	2	incubation in school	coho	340	86	5
Lakelse River/ Thornhill Creek	Thornhill Elementary School	30	2	incubation in school	coho	440	55	6
Lakelse River/ Thornhill Creek	Caledonia Secondary School	25	3	incubation in school	coho	300	73	5

Lakelse River/ Thornhill Creek	Copper Mountain Elementary School	32	2	incubation in school	coho	300	75	5
Thornhill Creek	Clarence Michiel School	130	4	incubation in school	coho	720	90	11
Thornhill Creek	Skeena Junior Secondary School	10	2	incubation in school	coho	350	88	5
Thornhill Creek	James Wold	10	4	incubation	coho	287,000	96	4,300
Tseax River	Uplands Elementary School	40	2	incubation in school	coho	340	86	5
Spring Creek/ Kitsumkalum River	Steelhead Society, Northwest Chapter	12	5	incubation stream improvement	coho	20,000	80	240
Bulkley River/ Morice River	Tadek Then	1	3	incubation, research	chinook	1,150	58	28
Morice River/ Upper Bulkley River	Emerson Creek Hatchery	—	3	incubation	chinook	107,500	90	1,250
Tseax River	Nishga Elementary School	11	5	incubation	coho	32,000	86	384
Rainy Creek	Stewart Secondary School Science Class	18	2	incubation in school	coho	Eggs killed due to poor temperature control.		

Contact: Barry Peters, SEP Community Advisor.

Table 36

North Coast SEP Facilities*: Juvenile Releases 1983

Species	Brood	Group	Total Released	% Marked	% Survival	Average Size(g)
Kispiox Band Project						
No releases in 1983; a new hatchery was built.						
Kitsumkalum Pilot Hatchery						
Chinook	1982	Kitsumkalum	75,000	0	N/A	2.5
Chinook	1982	Cedar	90,000	63	N/A	3.1
Kincolith Band Project						
Coho	1982	Kincolith	118,000	0	91	3.0
Babine Facilities						
Not available at time of printing.						

*Includes facilities constructed prior to SEP.
N/A means "not available."

Table 37

North Coast SEP Facilities*: Status at December 1983

Species	Stock	Brood	Stage	No. on Hand	Expected Release Date	Expected Release Number	Expected Release Site
Kispiox Band Project							
Not available at time of printing.							
Terrace Kitsumkalum Salmonid Enhancement Society							
Chinook	Copper R.	83	egg	12,600	Oct. 1984	11,000	Lower Copper River
Chinook	Lower Kitsumkalum	83	egg	86,500	May 1984	85,000	Lower Kitsumkalum
Coho	Kitsumkalum	83	egg	18,000	May 1984	17,500	Kitsumkalum
Kincolith Band Project							
Chinook	Kincolith	83	egg	85,300	June 1984	80,000	Lower Kincolith R.
Coho	Kincolith	83	egg	151,000	Sept. 1984	109,000	Upper Kincolith R.
Fort Babine Community Development Project							
Coho	Babine	83	egg	72,000	April 1985	N/A	Babine
Babine Facilities							
Not available at time of printing.							

*Includes facilities constructed prior to SEP.
N/A means "not available."

Table 38

North Coast SEP Facilities*: Adult Production

Species	Expected Production from 1983 Releases: Total Adult Production	Years of Return	Contribution to Fisheries	At Full Production: Total Adult Production	Contribution to Fisheries
Kispiox Band Project					
Chinook	No releases in 1983.			8,400	5,880
Coho	No releases in 1983.			10,000	7,000
Kincolith Band Project					
Coho	2,830	1984-1986	2,040	N/A	N/A
Babine Facilities					
Not available at time of printing.					

*Includes facilities constructed prior to SEP.
N/A means "not available."

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2

Federal Research

1. *Brood coho at Capilano hatchery are injected with Terramycin to control furunculosis.*

2. *This truck camper has been converted to a mobile laboratory for making field health checks.*

Federal Research

Juvenile Production Strategies

Size and Time at Release

The purpose of these studies is to determine the optimum size and time at release for juvenile salmonids in order to obtain maximum adult returns. Studies are either presently underway or have been completed on coho and chinook at Quinsam River hatchery and on coho at Capilano hatchery.

(a) Quinsam River hatchery coho studies

The first study began in 1980 with releases of three sizes of tagged juveniles (small, medium, large) on each of four dates (April 20, May 10, May 30, and June 19). Final fishery recovery data were obtained in 1983 and analysis of results completed. A report will be published in 1984. Response surface analysis predicts maximum adult returns of 11.2 percent (catch plus escapement) from release of 15.7-g juveniles on June 19. Since this weight is below the actual tested weight range for this date, a release weight of 20 grams is recommended until the lower weight can be tested; returns of about 10.2 percent are predicted for fish of this size. These results indicate adult production at Quinsam can be approximately doubled by releasing juveniles about two weeks later and 5 grams smaller than is the current practice. As in a previous study at Rosewall Creek, production of jacks was favored by early release of large juveniles. Most of the catch (41 percent) was taken by the net fishery, the remainder being divided approximately equally between the commercial troll and sport fisheries. The sport proportion increased with later release. There was also evidence suggesting selectivity by the fishery for males and larger fish.

A similar series of releases in 1981 provided comparative data. Escapement recoveries were completed in 1982, but final catch statistics will not be available until 1984. Preliminary analysis indicates results are very similar to those obtained from the 1980 releases.

In 1983, juveniles of three sizes were released on May 30. This was the optimum date indicated by preliminary analysis of data from the 1980 releases. This release was incorporated into a more elaborate study of density effects (by other investigators) with the intent of providing additional information on size effects. Jacks from this release were recovered in fall 1983.

(b) Quinsam River hatchery chinook studies

Tagged juveniles of three sizes (small, medium, large) were released on May 5, May 26, June 16, and July 7. The purpose of this series of releases was to provide comparative data to the releases in 1982. A data report of the 1982 releases was published in 1983.

A very small number of two-year-old jacks, resulting from the releases in 1982, were recovered in the escapement in 1983. Recoveries will continue until 1988.

(c) Capilano hatchery coho studies

The first study at this location was begun in 1981 with release of juveniles of three sizes (small, medium, large) on each of four dates (May 7, May 28, June 18, and July 9). Final escapement recoveries (adults) of fish resulting from this release were made in 1982. Escapement recoveries from a similar series of releases made in 1982 were completed in 1983. Final analysis of

the results of both studies cannot be done until fishery recovery data are complete, probably early in 1984. Preliminary analysis of returns from the 1981 releases suggests maximum adult returns from juveniles released in late May or early June at about 15-20 g. These values are very close to those already being used at Capilano. suggesting that any increases in production through changes in release strategy will probably be smaller at Capilano than at Quinsam.

(d) Plans for 1984

Recovery of adult chinook and coho will continue at Quinsam River hatchery. Analysis of and publication of results from all releases will continue as data become available. A time and size study on chum is proposed for 1984.

Steelhead Parental Age Studies

These studies, conducted at Rosewall Creek experimental hatchery, are designed to examine the influence of environmental and genetic factors on the early growth and on the age of steelhead trout at maturity. This information would be useful to fish culturists when selecting brood stock for specific purposes such as for the production of older, trophy-sized fish.

The first release of tagged juveniles was made on April 30, 1979. These fish were progeny of two groups of parents, one group having spent three years in the ocean, the other only two. Juveniles were graded into small. medium, and large size categories before tagging. They returned to Rosewall as 2-ocean adults in 1981 (192 recoveries) and 3-ocean adults in 1982 (44 recoveries). Analysis showed total returns (2- plus 3-ocean adults) grew significantly with the increasing size of juvenile for progeny of both parental types. Zero returns are indicated for juveniles of 23 grams or less. Increased returns relating to increased juvenile size was due almost entirely to greater returns of 2-ocean adults. Returns of 3-ocean adults varied and were unrelated to juvenile size. While neither parental age nor juvenile size affected the ages of returning fish, analyses suggest that the age structure of total returns can be altered indirectly by manipulating juvenile size. A higher representation of 3-ocean adults (as a proportion of total returns, but with no change in absolute number) is indicated if 2-ocean adult returns (and total returns) are reduced through release of smaller juveniles. Conversely, release of larger juveniles would increase returns of 2-ocean adults (and total returns) with no change in returns of 3-ocean adults.

In spring 1980, four releases (April 6, April 26, May 16, and June 5) were made, each composed of three size groups. Juveniles of the April 26 release were of 3-ocean parentage, all others were 2-ocean. Recoveries of 2-ocean and 3-ocean adults were made in 1982 and 1983, respectively. Returns were very low, but preliminary analysis suggests maximum returns from release of 50-g+ individuals in late April through early May.

In 1981, the initial 1979 experiment was repeated, but with a later release date (June 8). Juveniles released were progeny of both 2-ocean and 3-ocean parents. again divided into three size classes before tagging. Two-ocean adults recovered in 1983 showed very low returns (30 fish). This might have been caused by a low survival rate due to the late release.

In 1981, detailed crosses were made to examine the effect of parental age on freshwater growth as well as age at maturity. Thirty-two groups of fish, resulting from 2 X 2, 2 X 3, 3 X 2. and 3 X 3 parental ocean-age crosses using four sets of parents were reared and eventually tagged and released in spring 1982. These crosses were repeated in 1982 and the resulting 33 groups of tagged juveniles were released on May 2, 1983.

No new steelhead work was begun in 1983. Recoveries from the 1982 and 1983 releases will be made in 1984 through 1986.

Table 39

Fertilizers Added to Treated Lakes

Lake	Nitrogen (t)	Phosphorus (t)
Great Central	17.6	2.7
Kennedy	19.8	1.3
Henderson	10.6	1.6
Hobiton	1.8	0.3
Kitlope	5.0	0.8
Awun	2.0	0.3
Eden	2.1	0.3
Ian	5.4	0.8
Bonilla	3.4	0.5
Curtis	1.4	0.2
Long	11.0	1.7
Nimpkish	14.8	2.3
Yakoun	3.1	0.5

Contact: Tom Bilton, Research Scientist; Bruce Morley, Biologist; Doug Brouwer, Technician; Fisheries Research Branch, Pacific Biological Station, Nanaimo.

Lake Enrichment Program

Treatments

Thirteen lakes were treated with fertilizers in 1983. Lakes located on the Queen Charlotte Islands (Awun, Eden, Ian and Yakoun), on the north coast (Bonilla, Curtis and Kitlope), on the central coast (Long), and Nimpkish on Vancouver Island, were treated once a week for 16 consecutive weeks from May 29 to September 12. Other Vancouver Island lakes, Great Central, Henderson and Hobiton were treated twice per week and Kennedy-Clayoquot Arm once per week for 19 consecutive weeks from May 9 to September 13. In Kennedy, the nitrogen:phosphorus ratio was increased to 35:1 while the ratio applied to the other lakes was 15:1.

Contact: Ken Stephens, Project Manager, Fisheries Research Branch, Pacific Biological Station Nanaimo.

Juvenile Sockeye Studies

The aim of these investigations is to assess the effect of lake enrichment on sockeye production. Specific objectives include evaluating the growth and survival of juvenile sockeye to the smolt stage by monitoring various abiotic and biotic factors (temperature, zooplankton standing crop, growth and density of competitors) clearly linked to sockeye growth and survival, and by conducting quantitative comparisons between fertilized and unfertilized lakes.

As discussed in previous annual reports, enrichment may have two positive effects on sockeye production. First, growth of the fish is improved because food supply is increased. The larger smolts should return at a better rate than do smaller fish. Second, as a result of better conditions for growth, more fry should survive in the lake to produce a larger number of smolts from a given level of fry abundance.

In order to test these hypotheses, the abundance and growth of juvenile sockeye in fertilized and unfertilized lakes are compared. Abundance of sockeye in the lakes is estimated by combined hydroacoustic and midwater trawl

surveys. Smolts size is used as an index of sockeye growth. In 1983, estimates of juvenile sockeye abundance were made at twelve fertilized and nine unfertilized lakes. Smolt samples were collected from seventeen lakes.

Results so far indicate fertilization has a significant positive effect on sockeye growth in virtually all lakes studied to date. In coastal lakes, where moderate numbers of juvenile sockeye are present, fertilization usually results in the production of smolts that are 50 to 100 percent larger than those produced in the absence of fertilization. Complete results will be published in 1984.

The measurement of survival of sockeye during lake residence is much more difficult than the measurement of growth because of the problem of estimating fry input to the lake. Sockeye fry enter a lake from one or more streams. In many coastal lakes they also often emerge directly into the lake from shoreline spawning areas. Estimates of fry input under these conditions are very difficult and expensive to assess. Consequently, researchers use an index of fry survival based on the number of eggs in the parent spawners and on the number of presmolts present in the lake by fall or winter. This egg-to-presmolt survival index is sensitive both to variations in survival during incubation and emergence on the spawning grounds, and to variations in sockeye fry survival within lakes. This index is useful only where accurate data of spawner and progeny abundance are available and where egg incubation success is likely to remain relatively constant from year to year.

Accurate data of spawner abundance are obtainable at Great Central, Hobiton, Long and Sproat (unfertilized) Lakes because the fish must pass through counting facilities before reaching the spawning grounds. Fairly good estimates of spawner numbers are also available at Henderson Lake. Incubation success, however, at both Henderson and Long Lakes is quite variable because spawning takes place in headwater streams that are subject to wide variations in water flow conditions. Of the lakes studied to date, Great Central, Hobiton and Sproat are likely to provide the most reliable data for assessing the effects of lake fertilization on fry survival. This information will become available only when survival has been estimated at each of these lakes under both fertilized and unfertilized conditions.

The reliability of the within-lake survival index is also dependent on the accuracy of juvenile sockeye abundance estimates that are obtained through hydroacoustic and midwater trawl surveys. In 1983, the accuracy of hydroacoustic surveys was tested at Hobiton Lake. Adult sockeye were counted into the lake through a fence and smolts were counted out of the lake. Comparison of the estimates and counts showed that bias in the estimates ranged from 10 to 20 percent. If lake enrichment has a major (>50 percent) effect on within-lake survival, the present method of assessment will be sufficiently precise to demonstrate that effect.

Contact: Terry Gjernes, Research Biologist: Dr. Kim Hyatt, Research Scientist; Fisheries Research Branch Pacific Biological Station, Nanaimo.

Adult Sockeye Studies

In 1983, 15 lakes in coastal British Columbia (four on the Queen Charlotte Islands, seven on the mainland and four on Vancouver Island) had returns of adult sockeye from brood years associated with the fertilization program. Intensive assessment was carried out on three treated lakes (Great Central, Hobiton, Henderson) and one untreated lake (Sproat). Attempts to measure response of stocks to treatment in the remaining lakes are limited by high costs associated with lake logistics, inability to differentiate stocks in a mixed fishery and insufficiently reliable escapement data.

Information on response of sockeye broods associated with enrichment for assessable target stocks continues to accumulate. The total run (28,000) to Hobiton Lake was in line with expectations. The Hobiton run consisted predominately of five-year-olds (57 percent). The number of five-year-olds, combined with four-year-olds returning in 1982, indicate a high reproductive rate for the 1978 brood year which experienced treatment in 1979. As yearling smolts these fish averaged 4.7 grams, which is considerably larger than average for smolts produced normally by sockeye nursery lakes in coastal British Columbia. This observation adds to the scant knowledge of the positive relationship between smolt size and subsequent adult returns for treated lakes.

The runs to Great Central, Henderson, Sproat and Long Lakes were also strong in a year when sockeye stocks elsewhere in B.C. were well below expectation. The combined runs to Great Central, Sproat and Henderson provided a commercial catch of 863,000 sockeye (third largest on record) as well as record escapements to Great Central and Sproat Lakes (preliminary estimates: 350,000 and 250,000, respectively).

Studies are proceeding on age-specific marine survival rates for sockeye. Results to date indicate considerable annual variability for 2- and 3-ocean sockeye within and between stocks. For example, survival rates for Great Central Lake yearling smolts ranged from 1.1 percent to 9.9 percent for 2-ocean fish and 1.8 percent to 15.8 percent for 3-ocean fish. The average annual survival rate for 2-ocean sockeye was higher than that for 3-ocean sockeye (2.8 percent and 1.7 percent, respectively). To date, knowledge about the impact of nursery lake enrichment on marine survival of sockeye remains limited.

The program played a leading role in forecasting run sizes of certain treated sockeye stocks in 1983, and recommending optimal escapement size.

A report entitled "Abundance, upstream migration, age-composition and fecundity of Hobiton Lake adult sockeye salmon, 1982" was completed.

Contact: Dr. Kim Hyatt, Research Scientist; Jim Manzer, Biologist; Fisheries Research Branch, Pacific Biological Station, Nanaimo.

Limnology

Fifteen lakes (Awun, Bonilla, Curtis, Eden, Great Central, Henderson, Hobiton, Ian, Kennedy-Clayoquot Arm, Kitlope, Long, Lowe, Muriel, Nimpkish, and Sproat) were studied, and fertilizer was applied to all lakes except Muriel and Sproat. Most lakes were sampled once-monthly for a wide range of physical, chemical and biological variables.

In most lakes, fertilizer consisting of ammonium nitrate and ammonium phosphate in a nitrogen:phosphorus ratio of 15:1 was applied once weekly. Fertilizer was applied twice weekly to Great Central, Henderson and Hobiton Lakes, and in Kennedy-Clayoquot Arm fertilizer with a nitrogen:phosphorus atomic ratio of 35:1 was applied once weekly. Fertilizer applications on these four lakes were designed to reduce the relative abundance of phytoplankton species which are not a useable food source for zooplankton. The experiment on Kennedy-Clayoquot Arm was highly successful, as a deleterious nitrogen-fixing phytoplankton species which was very abundant in previous years was virtually eliminated from the lake. Results of the twice-weekly application experiments were not conclusive, so further analyses and experiments are required to verify the efficacy of this technique in improving trophic response.

As in previous years, the lakes exhibited considerable variation in their response to fertilizer additions; results were generally increased algal biomass and productivity, increased

zooplankton biomass, and consequently a greater food supply for juvenile sockeye.

Contact: Dr. John Stockner, Associate Director; Ken Shortreed, Biologist: Fisheries Research Branch, West Vancouver Laboratory.

Disease Control

A growing body of evidence indicates that chronic bacterial kidney disease (BKD) in salmonids causes greatest loss in cultured Pacific salmon after the fish have left their hatcheries and gone to sea. The results of feeding antibiotics to control the disease have not been satisfactory.

Data obtained at the Pacific Biological Station indicate that the slow-growing bacterium responsible for BKD depends to a large extent on vertical transmission (within the egg) for maintaining itself in salmonid populations. Fish hatching from infected eggs are probably an important source of BKD in salmonid hatcheries. Therefore, investigations are looking at the possibility of controlling BKD by breaking the infection cycle at the egg stage.

It is apparent that eggs taken from fish with cloudy coelomic fluid are always infected internally with the KD bacterium, and it is recommended that eggs from such fish should not be used for propagative purposes. The source of the infection in the eggs is the coelomic fluid surrounding the eggs. The presence of internal infections in "green" eggs was established by simply incubating the eggs in coelomic fluid containing high numbers (e.g. $--10^9$ cells/ml) of the pathogen. When the eggs were incubated in coelomic fluid containing lower numbers of the pathogen (e.g. $--10^4$ cells/ml), no intra-ovum infections were detected. Similar results were also obtained with the furunculosis bacterium. It appears, therefore, that eggs in brood fish stand a good chance of becoming infected if the infecting agent is small enough to pass through the micropyle and if it occurs in very high numbers. These results explain why, in nature, vertical transmission is likely to be important with the KD bacterium but not with the furunculosis pathogen. With the KD bacterium, the brood fish usually survive the high numbers of the pathogen necessary to ensure egg infections but with the furunculosis bacterium this is not usually the case.

A practical consequence of the foregoing findings is that it is now possible to obtain suitably infected eggs at will. As a result, studies on egg disinfection should be greatly facilitated.

Tests on egg disinfection to prevent the vertical transmission of the KD bacterium revealed that the surface of the egg could be readily freed from the pathogen using "tamed" iodine (e.g. --Ovadine) but that the iodine did nothing to reduce the intra-ovum infection rate. This has now been shown to be true even for eggs treated with iodine during water-hardening.

These results served to focus attention on erythromycin phosphate as a candidate antibiotic for treating eggs internally. Results to date with this antibiotic (and with less water-soluble forms of the antibiotic) reveal that high levels of the antibiotic is absorbed by the eggs after bathing them for only an hour or so in solutions of the antibiotic. Unfortunately, both the water-soluble and water-insoluble forms of the antibiotic appear to be leached from the eggs too rapidly for them to be effective against the intra-ovum pathogen. Consequently, the present practice of treating eggs with erythromycin may be a waste of time.

The search continues for an effective anti-KD bacterium antibiotic that is retained in the eggs for the 2-3 weeks that the data suggest may be necessary for intra-ovum disinfection. In the meantime, the only effective method for disinfecting eggs internally

is to maintain them in an antibiotic-containing environment (an impractical method) or to inject egg-bearing brood fish with high levels of erythromycin about a month before spawning. Eggs from such fish seem to retain the antibiotic indefinitely.

Contact: Dr. Trevor Evelyn,
Research Scientist, Fisheries Research Branch, Pacific Biological Station, Nanaimo.

Diagnostic Service

The Diagnostic Service is a continuing program responsible for monitoring the health of salmonids reared in the Pacific Region and for advising the fish culturist on corrective measures when serious fish health problems occur. The program, supported jointly by SEP and the Fisheries Research Branch, employs a staff of five at the Pacific Biological Station.

Generally health problems among intensively cultured salmonids seem to be the result of debilitating stress associated with artificial environments. High production levels require full utilization of available water and space conditions that can be conducive to outbreaks of infectious disease. Fish health depends, to a large degree, upon the hatchery manager's ability to recognize and avoid those environmental nutritional and biological factors which promote disease. The Diagnostic Service assists by checking for threatening disease agents and identifying the cause of any losses. Costly outbreaks are avoided by early detection of potential problems and prompt corrective or preventive measures.

The agent most frequently encountered by the Service continues to be Aeromonas salmonicida, the causative bacterium of furunculosis. This pathogen has a wide natural distribution in most coastal streams of British Columbia. In addition to causing losses among cultured juvenile fish, the disease can cause prespawning mortalities when naturally infected migrant adult salmon are held in confined space during egg-taking operations. Recent work has shown that an injection of Terramycin can effectively eliminate the disease from mature adult fish but the injected fish cannot then be used for human consumption.

Similar observations have been made with bacterial kidney disease, also a widespread disease of salmon. Experience has shown that once the causative organism is well established in a population of fish, antibiotics are of little help. Moreover, findings by Dr. T. Evelyn at the Pacific Biological Station indicate that the pathogen can be transmitted in the egg. Tests have shown injections of brood fish with erythromycin may be an effective means of breaking this parent/offspring mode of transmission.

Another frequently encountered disease is myxobacterial gill disease. Often found among sac fry and newly ponded fry, larger fish are rarely affected. Unless the outbreak is severe, losses can be minimized in most cases and the disease controlled by manipulation of the rearing conditions. The most important single factor in determining the severity of an outbreak is water quality.

Proliferative kidney disease (PKD), thought to be caused by a protozoan parasite, was found to be the cause of chronic mortalities of steelhead at the Puntledge River hatchery. The outbreak, complicated by concurrent furunculosis, subsided and has not been found since. This is the first known occurrence of PKD in Canada and the third in North America. In Europe, Idaho and California it has been associated with high losses among salmonids.

Signs of this hard-to-diagnose disease include anemia, popeye, abdominal distention, dark skin and a swollen greyish bulbously-ridged kidney. It is not likely that the causative organisms have been recently introduced to the Puntledge system but rather that improved sampling and laboratory procedures have led to their detection.

Contact: Gary Hoskins, Diagnostic Service, Fisheries Research Branch, Pacific Biological Station, Nanaimo.

Bruce Shepherd, New Projects Coordinator, Ted Perry, Biological Program Coordinator, Enhancement Operations.

Ceratomyxa Shasta Study

Two reports were produced by Envirocon Ltd. and EVS Consultants Ltd. in 1983; one dealt with the resistance of various Fraser River chinook stocks to Ceratomyxa shasta infection in fresh and salt water, and the second examined the rate of infection from March through November (infections occurred April through November). The results of these studies were summarized in the 1982 SEP annual report. In an additional study undertaken by Envirocon Ltd. in 1983, Oregon (Big Creek) and Capilano stocks were exposed to Fraser River water containing C. shasta. The Oregon stock, which is known to be resistant to C. shasta in the Columbia River, was also highly resistant (5 percent mortality) to C. shasta from the Fraser. The Capilano stock, which is known to be highly susceptible to the disease, was used as a control and showed 100 percent mortality. These results suggest that C. shasta is similar in virulence between the Fraser and Columbia systems, and that some stocks can be resistant. However, none of the Fraser stocks tested to date have shown any resistance.

Researchers at the Pacific Biological Station have proposed to continue investigations into the C. shasta problem in 1984 with routine seasonal sampling of smolts from the Fraser estuary. With regard to tagging studies, tag returns to date indicate that survival of 1981 brood Harrison stock released from the Chilliwack hatchery is approximately two percent to age two. If such high rates of return continue, it is unlikely that C. shasta is causing significant mortality in naturally-rearing chinook.

Contact: Gary Hoskins, Fish Health Biologist, Fisheries Research Branch;

Controlled Reproduction

The objective of this program is to develop new methods and to improve existing methods for the controlled reproduction of salmonids so as to facilitate stock enhancement, increase the landed value of the catch and provide new options for the management of the fishery

Contact: Dr. Ed Donaldson, Research Scientist, Fisheries Research Branch, West Vancouver Laboratory.

Controlled Sex Differentiation

The objective of this project is the development of methods for controlling sex in Pacific salmon and, more specifically, to develop the capability of producing sterile and all-female groups. A wide range of benefits would result from the successful development and implementation of sex control techniques.

Sterilization Projects

Sterile salmon do not mature sexually, develop precociously or migrate at maturity. These fish remain in the ocean and continue to grow for several additional years and as a result, provide larger fish for the commercial and recreational fisheries. This technique provides an effective means of redistributing surplus escapement to commercial and recreational fisheries. Because sterile fish do not mature, they do not undergo the unhealthy changes in flesh color and quality associated with sexual maturation. The sterilization technique can also be used to improve quality in stocks which are normally undergoing advanced sexual maturation at time of harvest.

In 1983, a small number of sterile coho from the 1980 release from the Capilano hatchery were harvested as

five-year-olds. These fish exceeded 60 cm in length with an estimated average weight of over 5.5 kg. The mean weight of adult coho from this facility at the normal age of capture (three years) is approximately 1.6 kg. Results to date indicate that the expectations of benefit from the sterilization of coho salmon are valid. In order to fully evaluate the economic and biological impacts of the use of sterilization on a production scale, the Capilano hatchery was scheduled to conduct three additional releases of coho. The first of these production-sized releases occurred in the spring of 1983, following treatment in 1982. In 1984, coho will be sterilized at the Big Qualicum and Thornton Creek hatcheries in addition to the Capilano hatchery.

The first of three planned releases of sterile chum salmon was conducted from the Thornton Creek hatchery near Ucluelet. The objective of these releases is to increase the value of the chum harvest through the production of fish which do not mature sexually and therefore, remain in silver-bright condition. These fish were marked for the purpose of assessing ocean survival and contribution to commercial fisheries.

All-Female Production Projects

The primary reason for producing all-female groups of salmon is to provide a means of increasing the proportion of females in a stock, thus permitting rapid enhancement where the supply of brood stock is a limiting factor. This technique is being developed for chinook salmon. Additional benefits from increasing the proportions of females in a stock include reducing jack production, increasing roe production and shifting the age distribution of the harvest where females are harvested in older age classes.

A further step towards the implementation of techniques for producing all-female groups of chinook salmon was taken in 1983. Milt from genetically all-female groups of chinook salmon which had been converted into males and reared at the West Vancouver Laboratory was used to fertilize 100,000 eggs at the Capilano hatchery. The resulting 100 percent female groups will be released in 1984. Survival and contribution to the commercial and recreational fisheries will be monitored.

Contact: George Hunter, Biologist; Dr. Ed Donaldson, Research Scientist, Fisheries Research Branch, West Vancouver Laboratory.

Induced Ovulation and Spermiation

The development of methods for the control of final maturation and ovulation in females and spermiation in males provides a means of both synchronizing and advancing spawning. Synchronized spawning may be used to reduce labor costs associated with egg-takes and allow efficient scheduling of production groups. Advancement of spawning allows prevention of prespawning mortality due to suboptimal adult holding conditions in either fresh or salt water. In the fall of 1983, pellets containing analogues of gonadotropin releasing hormone (LHRH) were implanted in coho salmon with some success. The successful development of this method of administering LHRH is advantageous since only a single handling of brood stock is required.

Contact: Dr. Ed Donaldson, Research Scientist; George Hunter, Biologist; H.M. Dye, Chemist, Fisheries Research Branch, West Vancouver Laboratory.

Polyploidy and Gynogenesis

Among the techniques for the control of reproduction and sex differentiation in salmonids that do not require the administration of sex hormones to induce sterility or to produce monosex stocks, chromosome manipulation procedures such as polyploidization and gynogenesis are seen as offering great possibilities.

Triploids, fish having an extra (third) set of chromosomes, can be artificially induced by applying hydrostatic pressure or temperature shocks

to newly fertilized eggs. The triploid chromosome complement in particular has the general effect, of inhibiting gonadal development in female fish.

Artificial gynogenesis applied to fish such as salmonids, in which females are homogametic, results in all-female offspring. The technique involves the obstruction of the paternal genetic contribution, by gamma irradiation and additional physical manipulation, to restore the zygote to the viable diploid condition.

The combination of these genetic techniques with steroid treatments offer promising alternatives for the control of sex in salmonids for aquaculture development and stock enhancement. Studies evaluating the growth, survival and maturational characteristics of triploid coho salmon will be continued in 1984.

Contact: Dr. Ed Donaldson, Research Scientist:
George Hunter, Biologist;
T. Benfey, Graduate Student,
Fisheries Research Branch,
West Vancouver Laboratory.

Fertility of Gametes of Chum Salmon Held in Sea Water and Fresh Water.

Spawning of chum salmon held in seawater pens has frequently resulted in high prespawning mortality and low fertility of eggs and sperm.

Experiments carried out in November 1982 at the West Vancouver Laboratory demonstrated that, under controlled conditions, the fertilization rate of eggs and sperm is equally high in chum held in both fresh (FW) and sea water (SW). Osmolarity of ovarian fluid of SW fish, although higher than that of FW fish, was substantially lower than levels observed during experiments in 1981, when fertility in SW fish was low. The results are in agreement with observations made in 1981 that osmolarity of ovarian fluid is negatively correlated with fertilization rate.

Analyses of plasma identified differences between FW and SW fish in plasma concentrations of hormones involved in egg maturation and ovulation. The ability of a gonadotropin-releasing hormone analog (GH-RHA) to advance ovulation was equal in SW and FW fish. The success in obtaining useable eggs and sperm from SW fish was significantly improved in GH-RHA-treated fish.

Contact: Dr. Joachim Stoss, Research Scientist,
Finnmark Landbruksskole 9850
Rustefjelbma, Norway; Ulf Fagerland, Research Scientist; George Hunter, Biologist, Fisheries Research Branch, West Vancouver Laboratory.

Magnesium Ions in Milt of Chum Salmon Spawned Out of Sea Water.

The effect of Mg++-ions in the intestinal fluid on fertility of sperm was determined in chum salmon held in sea water (SW) or fresh water (FW). Milt was obtained either by stripping or by withdrawal with a pipette from the sperm duct.

Mg++-ion concentration in stripped milt was low in FW fish but very high in stripped milt and intestinal fluid of SW fish. Milt obtained by pipette from SW fish was low. The motility of spermatozoa obtained by stripping and withdrawing with pipette was 24.1 and 75.6 percent, respectively. Corresponding fertility rates were 72.3 percent and 96.0 percent. The results suggest that Mg++-ions accumulate in the posterior portion of the gut and mix with milt obtained by stripping and so may reduce sperm fertility

Contact: Dr. Joachim Stoss, Research Scientist,
Finnmark Landbruksskole 9850
Rustefjelbma, Norway.

Salmon Genetics

The salmon genetics program was initiated in 1981 to study how natural populations of Pacific salmon are structured genetically, what the

genetic impact of artificial production techniques might be, and to initiate selective breeding programs in aid of SEP and regional mariculturists. This research will provide guidance for resource managers concerned about whether each population is a genetically unique stock or whether populations may be managed on a regional basis; what the genetic differences between hatchery-reared and natural salmon may be; and if genetic selection will improve the value of salmon catches or manageability of a hatchery stock. SEP has contributed funds to promote research on genetic variation (expressed as protein variability detectable via electrophoresis) within and between populations of chum and chinook salmon, and has largely financed the construction of a new building for genetic research at the Rosewall Creek experimental hatchery.

Sampling of chum fry and adults in rivers tributary to Tlupana Inlet confirmed the existence of genetic variation between five spawning populations of chum in this Inlet. These studies will be documented and sampling of adults returning to Conuma hatchery will be started in 1984. A similar study, initiated at the Quesnel hatchery, concerns electrophoretically detectable variation between chinook salmon from populations in the upper Fraser River. Assessing the genetic impact of this satellite hatchery on the gene frequencies of natural populations is part of a larger DFO research program investigating geographic variability in Fraser River chinook. Preliminary analyses indicate that differences in gene frequencies exist between lower Fraser, Thompson, and upper Fraser River populations. The genetic basis for red versus white chinooks is also being studied. Chinook salmon are considered to be red-fleshed; however, a small but consistent proportion of chinook apparently do not accumulate the pigment which causes the red color. The presence of white chinook appears to be variable between populations and likely has a genetic basis. Since red chinook are approximately twice as valuable as whites (in the marketplace), genetic selection or engineering could substantially increase the value of some cultured chinook populations. These experiments are continuing.

A research program in breeding was initiated in 1983. Research programs were initiated to compare production traits between several Georgia Strait and Fraser River coho populations; to assess the genetic and environmental determinants of jack production in coho; and to select coho for increased size at maturity. The latter project is being conducted in conjunction with the Quinsam River hatchery. Two generations of strong selection for increased body-size in a hatchery strain of coho will be compared with similar selection in a net-pen environment.

The genetics program will continue to evaluate genetic variation between Fraser chinook populations by documenting the results of previous work, and continuing research in the selective breeding of salmon. The program will aim at refining estimates of genetic variability of salmon populations by studying variability in base sequences of mitochondrial DNA in sockeye salmon. The impact of body-cavity parasites of the genus Philonema on egg and fry quality and survival of Babine Lake sockeye will also be studied.

Contact: Dr. Brian Riddell,
Research Scientist,
Pacific Biologist Station,
Fisheries Research Branch,
Nanaimo.

Fish Nutrition/ Smolt Quality Program

During 1983, work on fish nutrition was directed to:

- determine acceptable dietary components for pink salmon cultured in seawater and evaluate whether extended freshwater rearing of pink salmon was possible by alteration of dietary salt content and composition
- develop economical practical dry

diets for rearing chinook salmon at cold and warm water temperatures

- determine the nutritional cause(s) of bilateral lens cataracts in juvenile chinook salmon
- optimize the biochemical characteristics of hatchery-reared chinook salmon before release to enhance their ocean survival
- maintain strict quality control of local and imported foods.

These goals were set because:

- the composition of conventional commercial foods, based on the ingredient preferences and nutrient requirements of chinook and coho salmon, may not be ideally suited for rapid growth and survival of pink salmon either in fresh water or seawater
- high quality dry diets ($\leq$ 10 percent moisture) are less expensive to manufacture, transport and store than the semi-moist Oregon moist pellet (OMP) diet (30 percent moisture) currently in use in B.C. hatchery facilities. Moreover, dry diets unlike OMP, are easy to dispense through automatic feeders
- suboptimal dietary levels and/or balance of nutrients are known to induce noninfectious diseases such as bilateral lens cataracts
- preliminary evidence suggests that body composition of hatchery-treated smolts influences their subsequent survival, independent of the effects of size and time of release
- diet quality control is essential to ensure optimal growth, food conversion, health and survival of salmon.

Major accomplishments in 1983 included finding that pink salmon growth and survival in seawater bore a direct relationship to dietary zooplankton content. After 42 days of culture, final mean weights of juvenile pink salmon fed a test diet in which 34 percent of dietary protein was supplied by freeze-dried euphausiids were three times higher than those of fish fed OMP. This finding has important implications for improving the ocean survival of hatchery-reared pink salmon. Manipulation of dietary salt content did not facilitate extended freshwater rearing of juvenile pink salmon.

At Robertson Creek hatchery, a food study assessing the performance of juvenile chinook fed OMP, Bio Diet, Moore Clarke intermediate moisture diet and the West Van 33 dry diet, showed that the latter diet is a very promising substitute for OMP. Return data for 1978 brood chinook fed West Van dry diets or OMP during freshwater residency indicated significantly improved survival for fish fed the dry diets. At the Qualicum hatchery, juvenile chinook salmon fed the West Van 33 dry diet or OMP had identical performance despite initial rearing temperatures of less than 8°C.

Laboratory studies showed that life history stage influences the incidence of bilateral lens cataract (blindness) in juvenile chinook salmon during periods of poor nutrition. Juvenile chinook salmon growth, appetite, food conversion, survival and cataract incidence were dramatically influenced by varying dietary concentrations of calcium, zinc and phytic acid (mineral binding agent present in plant proteins). These findings will contribute to the establishment of acceptable ranges for calcium, zinc and phytic acid in practical salmonid foods. They also suggest that reduction of the ash content of fish meal should permit more rapid growth of juvenile chinook before they enter seawater, which in turn may improve ocean survival.

Robertson Creek hatchery chinook smolts of similar size and body energy reserves, but of different body lipid composition, were differentially tagged and simultaneously released to evaluate whether body lipid composition influences adult returns. Clearcut trends in returns of 1979 and 1980 brood juvenile chinook have not emerged yet. The diet quality control program revealed anomalies in the aluminum and bacterial content of OMP. Bacterial contamination of OMP may have been a major factor in losses of juvenile chinook salmon at Robertson Creek hatchery in 1983. Work in 1984 will be

directed to:

- preparing the results of previous laboratory and field nutrition studies for publication
- improving diet quality control specifications
- conducting large-scale field studies on chinook and pink salmon to show the economic and practical advantages of using West Van diets.

Contact: Dr. Dave Higgs, Research Scientist; J.R. Markert, Chemist; Fisheries Research Branch, West Vancouver Laboratory.

Smolting Requirements

This research is conducted to measure the development of the ability of juvenile salmon to adapt to seawater, as influenced by rearing environment, size and time of release. The purpose is to determine optimal rearing conditions for juvenile salmon and to evaluate a 24-hour seawater challenge test as an index of marine survival.

Seawater challenge tests conducted in conjunction with the second chinook time-and-size-at-release experiment at the Quinsam hatchery confirmed that all groups had a high degree of seawater adaptability at the time of release. The fish were larger than in the previous year and there was no marked effect of size on the ability of fish to adapt to seawater.

Tests were also conducted on chinook from Robertson Creek, Puntledge, Thornton and Conuma hatcheries as well as on coho and steelhead at Robertson Creek. Overall, the results of these tests at production hatcheries on Vancouver Island indicate that steelhead smolts attain maximal seawater adaptability in April, coho smolts in late May and chinook in late May or June.

Fall chinook fry from the Big Qualicum hatchery were reared at 8°C from May through November to better define the pattern of seawater adaptability during summer and autumn. Seawater adaptability remained high from early June through September and then declined sharply during October.

The program was scheduled to be discontinued in 1984. The results of the research are being prepared for publication, beginning with a technical report on revisions to the seawater challenge procedure.

Contact: Dr. W. Craig Clarke, Research Scientist, Fisheries Research Branch, Pacific Biological Station, Nanaimo.

Stress and Histophysiology

Fish raised in enhancement facilities are exposed to culture practices such as crowding and handling which induce stress and subsequently result in lowered disease resistance and growth potential.

During 1982, research in this area centered on the assessment of the effect of ponding density on growth characteristics and ocean survival of two consecutive broods of coho raised at Quinsam River hatchery.

1981-Brood Coho

Juvenile coho were ponded in late May, 1982 at four densities. The initial densities, calculated from tagged/untagged ratios established in December, ranged from 72,988 to 121,299 fish per pond. At time of tagging, a fraction of each fish population received coded-wire tags, equal-numbered subpopulations of small, medium and large size fish being identified with individual codes. Smolts were released on May 30, 1983.

Total mortalities, mainly ascribed to furunculosis, ranged from 1.6 - 24.8 percent and were inversely related to initial ponding density. Weight gain and food conversion efficiency during the rearing period were highest at the lowest density.

1982-Brood Coho

In early June 1983, coho fry were

loaded into six ponds at three replicated densities. Initial loading densities calculated from marked/unmarked ratios established in November, ranged from 51,880 to 101,738 fish per pond. Small, medium and large size fish again received individual tag codes. Attempts were made to regulate average fish size by adjusting food intake from time to time. Mortalities to December, 1983 ranged from 1,427 to 18,264 fish per pond and were, as in the previous study, inversely related to ponding density.

Contact: Ulf Fagerlund and Jack McBride, Research Scientists, Fisheries Research Branch, West Vancouver Laboratory.

Incubation and Water Quality

Projects concluded or underway were intended primarily to develop water quality standards during egg incubation and to improve and standardize certain techniques used in salmonid hatcheries.

Contact: Dr. Don Alderdice, Research Scientist, Fisheries Research Branch, Pacific Biological Station, Nanaimo.

Influence of Total Gas Pressure (TGP) on Salmonids

Several years ago, it was recognized by field biologists of the Facilities Operations Division (SEP) that supersaturation with atmospheric gases could be a problem in various hatchery water supplies. Several projects were conducted at the Pacific Biological Station to examine this TGP problem in eggs and alevins. In 1983, the Water Use Unit (Field Services Branch) requested further information regarding potential TGP problems in the Nechako and Nanika Rivers in central British Columbia. These are related, respectively, to discharge of water from Kenney Dam, and to the proposed damming of the Nanika River below Kidprice Lake.

Growing concern with both problems precipitated a major search for relevant information. A number of TGP research projects were examined, conducted largely as a result of problems occuring after construction of dams on the Columbia and Snake Rivers in the U.S.A. From these, a set of 70-odd data points has been obtained. These provide a general examination of the problem and the factors involved.

Fish inhabiting supersaturated water may suffer the "bends". There is tendency for bubbles of excess gas to form in the blood and tissues. These may block circulation of blood in the vascular system or cause damage by their growth in tissues. Effective time to 50 percent mortality (ET50) in a sample of juvenile salmonids exposed to supersaturated water appears to be slightly more sensitive to nitrogen than oxygen gas level. ET50 response was found to be a function of these variables:

- O_2/N_2(%)
- TGP(%)
- Temp (°C)
- barometric pressure (mmHg)
- fish length (mm).

At the present stage of analysis, species differences appear to be rather small. In general, the nature of the relations between these variables is that there is a rectangular hyperbolic relationship between ET50 and levels of TGP. At each TGP level, a family of hyperbolae may be generated depending on the O_2/N_2 ratio. Each member of each family is further modified by temperature, barometric pressure and fish length. Fish appear to be most sensitive to supersaturation at $O_2/N_2<1$. Our current estimate of a "most sensitive threshold" is for O_2/N_2 ratios near 0.6 and a TGP of 102 - 103 percent. Research on the problem is continuing.

Contact: John Jensen, Biologist; Dr. Don Alderdice, Research Scientist; Fisheries Research Branch, Pacific Biological Station, Nanaimo.

Critical Oxygen Requirements of Salmonid Eggs and Alevins

A three-year project to define the critical oxygen requirements of salmonid eggs and alevins, from egg fertilization to swim-up, is complete. Critical oxygen levels are those below which uptake requirements cannot be satisfied by environmental supply. Critical levels have been determined for the five British Columbia species of Pacific salmon and also steelhead trout over useful ranges of temperature (5.0-6.0 to 12.5-15°C) and bulk water velocities (100-3000 cm/hr). Along with temperature-development time relations from fertilization to swim-up (reported below), these data will permit the modelling of development and the automation of various hatchery procedures during incubation. With the available hatchery desk-top computers, knowledge of ambient oxygen levels in the water supply; daily temperature; water flow rate; number, position and loading rate of egg trays in a vertical stack, date of fertilization, it should be possible to:

- minimize water use during early incubation (if desired)
- forecast hatching time in individual trays
- watch for potential "hot spots" if critical oxygen levels are approached
- adjust tray densities (and possibly flow rates) to avoid approaching critical levels
- forecast the optimum time to pond alevins.

When these new criteria are applied, marginal oxygen conditions may be found more frequently than might be anticipated. This is not surprising, considering there were no empirical low oxygen guidelines previous to this study. In the lower third of Heath stacks and in incubation boxes and at current loading densities, critical oxygen levels may be reached and surpassed in advanced eyed-eggs and in alevins before ponding. Fry quality may be affected in eggs and alevins subject to oxygen levels below critical requirements. With new criteria, that possibility can now be studied.

Contact: Dr. Peter Rombough,
Biologist, Fisheries Research Branch,
Pacific Biological Station,
Nanaimo.

Shock Sensitivity of Chinook Eggs

A series of tests has been completed to examine the sensitivity of chinook eggs to mechanical shock. The test series was identical to an earlier one on coho eggs. At 10°C, shock sensitivity of the larger chinook eggs follows the same pattern of sensitivity of the smaller coho eggs. In general the chinook egg is somewhat more resistant than the coho egg to mechanical shock.

Contact: John Jensen, Biologist,
Fisheries Research Branch,
Pacific Biological Station,
Nanaimo.

Effect of Egg Size on Optimum Ponding Time for Chinook Alevins

Several years ago, research was carried out on the relationship between incubation temperature and optimum ponding time for chinook alevins. Subsequently, it was found that there was substantial variation between experimental results and those obtained for similar eggs and alevins from various production hatcheries. The reason for these differences became apparent when new data were being analyzed to determine the critical dissolved oxygen levels for chinook eggs and alevins.

The optimum time to begin feeding chinook alevins is closely associated with their attainment of maximum alevin wet weight (MAWW). It was found that egg size, as well as temperature, influences rate of development and time to MAWW. A good predication of time to MAWW is given by:

$$\ln d = 5.88 - 0.152T + 0.000513W$$

where d = days postfertilization to MAWW, T = mean incubation temperature (°C) and W = mean initial water-hardened egg weight (mg). If variability in egg size is high, the lower 95 percent

confidence limit for initial egg weight (W) should be used. If initial egg weight is unknown, a value of 200 mg for W should provide a very good estimate of time to MAWW.

Contact: Dr. Peter Rombough,
Biologist,
Fisheries Research Branch,
Pacific Biological Station,
Nanaimo.

Time/Temperature Relations in Development of Pacific Salmon Eggs

The relation between incubation temperature and development time to hatching has been the subject of many empirical models. Solution of this problem became a critical requirement in relation to the increase in modelling of events occurring during hatchery culture (see Critical Oxygen Requirements). Time/temperature relations to hatching have now been examined using J. Schnute's general growth model. This technique has proven to be the most efficient of all empirical models examined. Equations will be provided for five species of Pacific salmon, and steelhead, as soon as analyses are completed.

Contact: Frank Velsen and John Jensen,
Biologists, Fisheries
Research Branch,
Pacific Biological Station,
Nanaimo.

Fine Structure of the Salmon Egg Capsule

Fine structure of the egg capsule has been determined for the five species of Pacific salmon and the steelhead trout. The work is basic to the advancement of two other projects, one involving critical oxygen levels and transfer of gases across the capsule, and the other the relation of water hardness and internal egg pressure to normal egg development. For the species indicated, the capsule is a multilayered structure 28 m (coho) to 62 m (pink) in thickness. Externally there is a "jelly" coat (easily removed), a thin external layer 0.2-0.3 m thick, a thick internal layer (24-55 m) and, except in coho and chinook, a subinternal layer (3-8 m thick). Pores occur on the inner and outer surfaces of the capsule, and these are connected by pore canals traversing the capsule. The pores are arranged in a hexagonal pattern, except in the sockeye where the external pores are blocked by plugs. Density of the external pores varies between 3.5×10^5 (chinook) pores/mm^2 and 4.8×10^5 (sockeye) pores/mm^2. Pore canal width varies between 0.5 and 0.8 μm. The structure of the internal and subinternal layers resembles that of the intima of the mammalian aorta. Both appear ideally suited to changing internal pressures and tensions. The capsule is highly permeable to water, dissolved gases and ions. It appears the only reasonable course for mass transfer of these particles across the capsule is via the pore canals.

Contact: Eric Groot, Biologist; Dr. Don Alderdice, Research Scientist; Fisheries Research Branch,
Pacific Biological Station,
Nanaimo.

Hatchery Water Quality Criteria

In 1983, a report was completed on analysis methods applicable to the prediction of aeration of hatchery water supplies. Two additional studies were undertaken in 1983; one further developed design and analysis procedures for hatchery aeration systems, and the other focussed on the study of biophysical phenomena associated with gas bubble disease (Gas bubble disease in fish is analogous to the "bends" in human divers, and occurs in supersaturated water). The first study was done for SEP Engineering, with some assistance from SEP Enhancement Operations. The latter study is part of a larger investigation program undertaken jointly by SEP Enhancement Operations staff and the Incubation Research Group at the Pacific Biological Station (see section on supersaturation research program).

Sigma Resource Consultants Ltd. completed the revised edition of their

report, Summary of Water Quality Criteria for Salmonid Hatcheries, in 1983.

Contact Bruce Shepherd, New Projects Coordinator, Bill McLean, Operations Support Biologist, Enhancement Operations; Adrian Rowland, Project Engineer, Engineering Division.

Chum Incubation Requirements

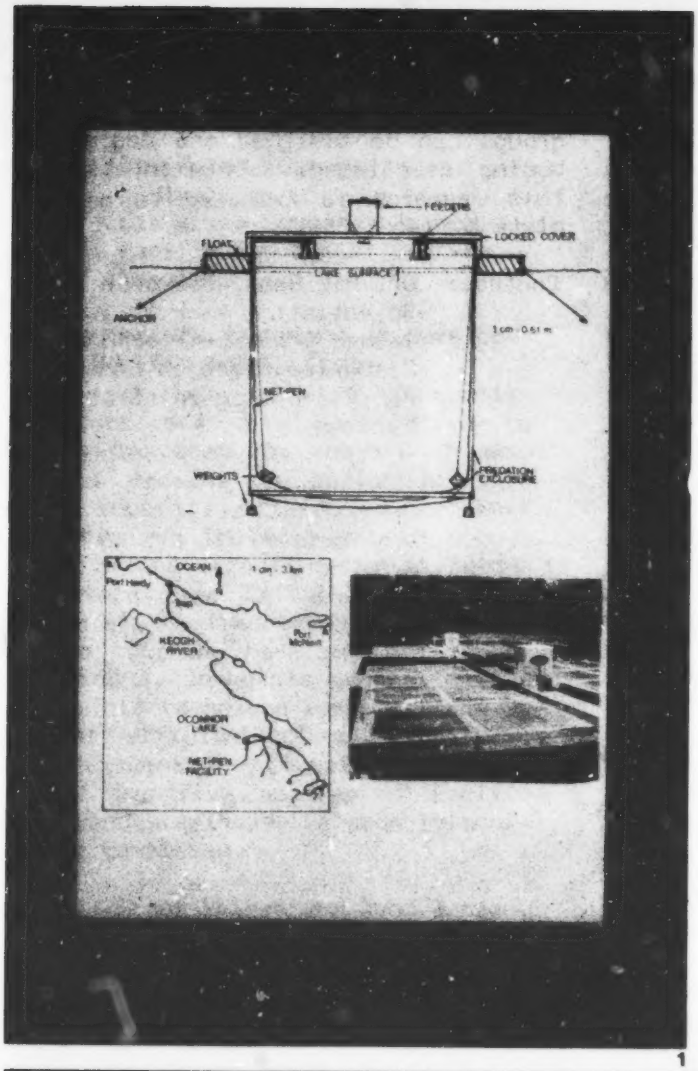
Homing and Straying Project on Conuma Hatchery Chum Salmon

This project, conceived in 1979, was intended to investigate the accuracy of homing of centrally-reared chum salmon following imprinting in the parent stream during periods of various duration from zero to 16 days. The study was designed to discover how long off-site reared chum salmon would need to be retained in their parental stream prior to release to ensure homing accuracy similar to that shown by naturally propagated fish. Good homing is believed to be essential to maintaining genetic integrity of different stocks and is important in distributing returning adult fish at optimum densities over fishing and spawning grounds.

Only the control group of the experiment (i.e., the naturally propagated fish) were marked in spring 1981 to establish the natural homing rate. In addition to this group of 110,000 fry, several other, hatchery-reared, chum fry were marked and released in several rivers of the Tlupana Inlet complex. In 1983, an intensive recovery effort was launched to obtain as many marked adults as possible to develop a broad understanding of the homing patterns of these several chum stocks. This program will be repeated in 1984, when the four-year-old marked wild fish will be available for study.

Approximately 1,800 marked fish were recovered from five streams and measurements and scales for age determination were taken. All fish require ageing before they can be assigned to their respective sources because all marks, including the one used on the wild fish, were also used in other years on groups of fish from different origins. Once ageing is completed, groups can be assigned and degrees of homing calculated. Documentation of this research is expected to be complete by late 1985.

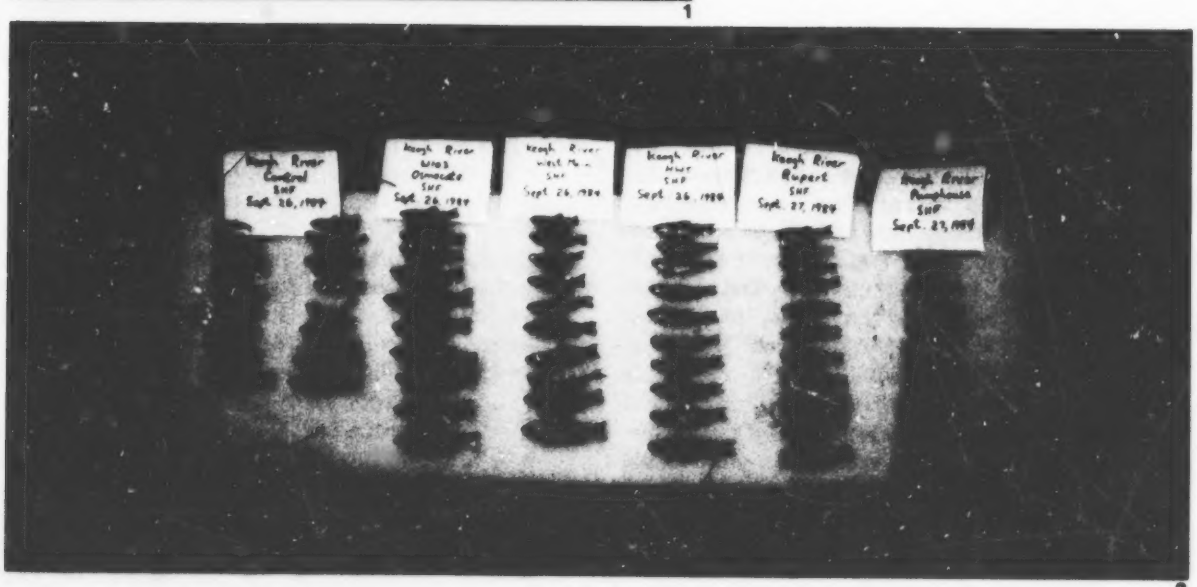
Contact: Dr. Rob Bams. Research Scientist; Dennis Crabtree, Technician; Fisheries Research Branch, Pacific Biological Station, Nanaimo.



1

Provincial Research

1. *Detail drawing and insert photo of floating net pens used to rear steelhead at O'Connor Lake.*
2. *Tests showed how steelhead fry responded to various applications of inorganic fertilizer to the Keogh River.*


Keogh River Control SHF Sept. 26, 1984
Keogh River with Ozonide SHF Sept. 26, 1984
Keogh River west Main SHF Sept. 26, 1984
Keogh River Alum SHF Sept. 26, 1984
Keogh River Rupert SHF Sept. 27, 1984
Keogh River Ammonium SHF Sept. 27, 1984

2

Provincial Research

Headwater Stocking

Hatchery-produced steelhead smolts are used to augment wild steelhead populations. However, because of the high cost of hatchery production and the various effects that hatchery fish may have on wild populations, alternate ways to enhance wild populations are being examined.

Utilizing rearing areas above obstructions is one potential method of enhancing wild steelhead stocks. The objectives of this research project were to assess the biological and economic feasibility of stocking steelhead fry in headwater areas.

In 1983, the final data on the Englishman River were collected. The experiments on the Englishman River were designed to investigate the growth and survival of fry from stocking at different times and sizes. A smolt trap was operated on the Englishman in spring 1983 and afterwards a census was carried out in the stocking areas.

Data analysis is virtually completed and the final reports should be published in 1984. Final interpretation of the analysis has not been completed, but some results are apparent. Best survivals were achieved by release of large fry (4 to 6 g) in early October, after low summer flows but before winter floods and cold water temperatures. Increased stocking density also adversely affected fry survival, but there appeared little effect at densities below 0.5 fry/m^2. The best utilization of habitat and the best survivals were achieved by scattering fry over the release section at the desired density. If due to staffing constraints or access problems the fish must be released in groups at relatively few points, then their subsequent dispersal determines the rearing density.

Contact: Jeremy Hume,
Fisheries Biologist,
Fish and Wildlife Branch,
Vancouver.

Keogh Pilot for Steelhead Enhancement

Several years of research and development work have been conducted on the Keogh River on northern Vancouver Island to:

- develop a biophysical model for prediction of steelhead smolts and adults
- assess the harvestable surplus of winter steelhead in a typical coastal river
- evaluate the feasibility, constraints and cost-effectiveness of several enhancement techniques including instream enhancement, net-pen rearing in lakes, fry stocking above barriers, and stream enrichment. Some of these have been reported in earlier annual reports.

Wild Steelhead Survival and Production

Age-specific survival data have been summarized for the wild steelhead trout population. Egg-to-fry survival has averaged 7.4 percent over seven years and ranged from 2 percent to 12 percent; survival was negatively correlated with rainfall in the spring (high rainfall, poor survival). Fry-to-smolt survival from 1976 to 1979 averaged 13 percent and ranged from 5 percent to 19 percent. Smolt-to-adult (wild steelhead) survival over three years has ranged from 8 percent to 14 percent and averaged 12 percent (excluding repeat spawners). Survival of kelt steelhead

from tidewater exit to return the following year has averaged 26 percent (range 8 to 44 percent) and have comprised on average 10 percent (range 4 to 26 percent) of the total run of steelhead.

A preliminary model was completed that predicts parr density, smolt yield and adult numbers utilizing physical and chemical measurement of rearing habitat. Further refinement is continuing because the existing model is not applicable to streams with high late summer flows.

Minimum fry recruitment densities at summer flows (30-day mean low; e.g. -- July to September) have also been identified for these types of oligotrophic rivers. A critical threshold of 0.2 fry/m^2 of total wetted area at summer flow conditions (30-day mean low) is necessary to utilize most of the parr habitat, but an optimum target density to approach saturation was about twice this level owing to high variation in juvenile survival, particularly during high winter freshets. High annual variations in egg-to-smolt survival rates suggest there would be considerable uncertainty in describing stock recruitment relationships even after several additional years of data collection. Restrictive harvest regulations that permit only a small harvest of wild fish in March and April, now in place for most winter steelhead fisheries on Vancouver Island, are good alternatives to ensure stocks approach their habitat capacity.

Residualism Studies: Management Implications

Residualism (or failure to migrate) of hatchery steelhead smolts is considered a serious problem by fishery managers owing to impacts on both wild juvenile production and return rates of hatchery adults. Four years of examination at Keogh has demonstrated migration success of about 50 to 93 percent. Fish weighing 60 to 70 g stocked low in the river (e.g. -- 1.5 km upstream) had the highest out-migration success (93 percent). Small smolts (< 41 g mean) and large smolts (105 g) stocked low in the river performed poorly (about 70 percent migration), but were better than 65 g smolts stocked high (11 km upstream) in the river (50 percent migration). Residuals sampled in the river were highly biased to males (3:1, and up to 6:1 for the group of large-size smolts (105 g). Further migration after a second year of rearing has been negligible. Additional studies conducted at Little Campbell River, where large steelhead smolts (120 g) were stocked 10 to 14 km upstream, also confirm poor migration success (57 percent) and high residualism which was also biased to males.

With the exception of restorative stocking, smolts should be stocked only in the lower reaches of small rivers that are managed as augmented rivers for both wild and hatchery steelhead. Also, smolts should be stocked at a size of 60 to 80 g to minimize undersized and oversized fish (particularly males) that fail to migrate. Adherence by fishery managers to these two guidelines should greatly improve return rates of hatchery steelhead to the river and sport fishery, as well as reduce impacts on wild steelhead production.

Survival of Cultured Winter Steelhead Smolts

Steelhead cultured in net pens at O'Connor Lake (in the Keogh system) have been returning for two years. Preliminary analyses indicate an average rate of return of 13 percent for wild steelhead including repeat spawners. By comparison, two broods of net-pen reared smolts (60 - 65 g mean weight) released 1.5 km from the ocean returned at 5.8 percent and 6.6 percent including repeat spawners, or > 50 percent greater than the SEP biostandard of 4 percent for conventional hatchery steelhead.

A preliminary comparison of steelhead smolts released near the river mouth to a group released 11 km upstream, indicates a 30 percent higher return rate for 2-ocean fish for the

Table 40

Steelhead Smolt Production from O'Connor Lake Net-Pen Facility

Species	Brood	Stock	Stocking Site	No. Smolts ('84 Stocking)	Average Size(g)	Comments
Winter Steelhead	1983	Keogh	Keogh River	37,500	71 g	early run, late run and early/late run cross
Winter Steelhead	1983	Quatse	Quatse River	12,000	80	early and late run
Summer Steelhead	1983	Tsitika	Campbell River	5,500	73	designed to establish a summer run in Campbell River

lower river stocking site (3-ocean fish return in 1984/85). Further annual evaluations of returns from these groups, including early and late-run groups and ocean release groups are required.

Lake Pen Rearing of Steelhead Smolts

Until recently, there have been few attempts to develop net-pen culture of salmonids in lakes, although there are several advantages including low capital costs and higher smolt-to-adult survival. Research and development investigations at O'Connor Lake in the Keogh River watershed were designed to:

- determine if fish could be reared consistently to an average weight of 60 to 70 g at release
- resolve operational constraints including high temperature, ice formation and predation
- determine effects of rearing density on fry-to-smolt growth, quality and adult return rates
- examine effects of feeder designs and frequency on growth and quality of smolts
- contribute to the assessment of survival of various smolt groups stocked at various locations
- contribute to steelhead production targets in the region.

During 1983, production of Keogh River and Quatse River winter steelhead smolts exceeded and met targets respectively. Tsitika River summer-run steelhead, for stocking in Campbell River, were well below target owing to brood stock shortfalls.

Several subgroups were reared in 1983 to 1984 including early-run Keogh stock (17,600), late-run Keogh stock (13,800) and early/late crosses (6,100); the latter two groups primarily to compensate for the unexpected shortfall of Tsitika stock. Mean weights ranged from 67 to 88 g for all groups and stocks.

Several research experiments were conducted at the net pen to compare feeding frequencies (0.5 hour versus 4 hour) and feeder type (demand versus conventional) in terms of growth and quality of smolts. The 0.5 hour interval feeding produced better quality smolts and slightly better growth than the 4 hour interval. Demand feeders (4 per pen), started in September, performed better for growth but quality (fin erosion, scale loss) was not as good as the 0.5 hour conventional feeders. Approximately 20,000 of the Keogh steelhead smolts were graded into "good quality" and "poor quality" groups that were similar in mean weight. Returns of these as adults will be compared to provide further insight into the effects of fin erosion and scale loss on post-release survival.

Total production of smolts in 1983/

84 clearly demonstrated that a net-pen facility in an appropriate lake, similar to O'Connor, can be operated at a cost-effective scale. In addition, returns of steelhead adults are 50 percent higher than for conventional hatcheries.

Owing to the completion of research at the O'Connor facility, and the provincial government restraint program, further steelhead smolt production will cease at O'Connor Lake. Most of the facilities will be donated to the North Vancouver Island Salmonid Enhancement Society for coho rearing in 1984/85 and possibly further steelhead culture in 1985/86.

Stream Enrichment

Stream enrichment research has been conducted, provincially, since 1981. In 1981, it was demonstrated that growth of periphyton could be stimulated by additions of nitrate and phosphate, which stimulated the food chain, increasing growth of coho salmon and steelhead trout. After 2.5 months of enrichment, both species reached the size that typically requires a complete year to reach.

In 1982, research efforts were directed at use of trough experiments to examine at what levels phosphorus limitation occurs. No nitrate limitation occurred at background levels (80 to 180 µg/l), and phosphorus levels up to 10 µg/l stimulated periphyton growth substantially. Experiments were also conducted on release rates of Osmocote slow-release fertilizer in preparation for a whole-river treatment of the Keogh River, conducted in 1983.

In 1983, about 70 percent of the Keogh River was treated with Osmocote fertilizer, applied by helicopter in three applications (2-month releases). However, stimulation of the periphyton-insect-salmonid food chain was marginal because release rates were twice as rapid as in laboratory tests and an unusual flood in July scoured the substrate of colonized algae. Stimulation of the food chain and salmonid density and growth increments were not statistically detectable during summer.

Further Osmocote tests were repeated in Keogh River water and within hatchery troughs. However, owing to uncertainties in release rates in relation to flow, the treatment of Keogh River in 1984 will incorporate one Osmocote section, one phosphorate-only section using a dispenser and conventional fertilizer, and a longer nitrate plus phosphate treated section with 7 conventional fertilizer dispensers at 3 km intervals.

Contact: Pat Slaney,
Senior Research Biologist;
Fish and Wildlife Branch,
Vancouver.

Disease Diagnostics

Disease Background for Enhanced Populations

Steelhead and cutthroat trout enhancement often requires the transportation of adults and/or eggs from one water system to another. The health status of the wild adults from the various river systems must be determined in order to reduce the risks of transferring and disseminating disease agents and jeopardizing the health of progeny. In cases where hatcheries are involved with rearing the progeny, the importation of a disease agent into the hatchery water supply could result in disastrous losses. To provide a disease history on steelhead and/or cutthroat native to various rivers, spawned adults from eastern Vancouver Island, Lower Mainland, Cariboo and Skeena are examined for diseases.

A reduction of staff in the Fish Health Section, which works out of the Pacific Biological Station, required that work priorities be examined closely. Priority was given to those stocks having a history of disease and which were moved between river systems or were to be cultured in a hatchery recycle system. In 1983, 350 adult

steelhead, cutthroat and chinook from 32 river systems were examined. The bacterium causing furunculosis was found in eight stocks and was therefore the most prevalent disease organism.

Ceratomyxa shasta, a myxosporidian parasite, was again found in 4 percent of the cutthroat examined from the lower Fraser River and five of nine chinook salmon from the Bonaparte and Deadman Rivers.

Disease Prevention and Treatment in Cultured Stocks

Steelhead and cutthroat juveniles are being reared at various sites, including net pens in lakes, satellite hatcheries, earthen fish ponds, and large hatchery facilities. The diverse physical and chemical water conditions at these rearing sites present opportunities for disease outbreaks or conditions which stress the health of the fish.

In October, losses in Colquitz cutthroat fingerlings held in earthen ponds in Saanich began to increase. Examination of fish revealed no disease agents, but sectioning of the gills revealed major damage to gill tissue. At the time of increasing fish mortality, the pond water was murky and the presence of algae was extensive. Chemical analysis revealed high ammonia levels as the probable cause of the fish health problem.

Approximately 1.5 months after capture, Oyster River adult cutthroat exhibited flashing and minor external hemorrhaging (petechiation) at the Vancouver Island hatchery at Duncan. Salmincola sp, an external copepod parasite which was picked up in the wild, was multiplying rapidly in the warm (14°C) hatchery water and causing the fish some discomfort. Treatments with formalin killed the immature forms of parasite, but adult forms had to be manually removed with forceps.

Parasites also presented a problem at the Fraser Valley trout hatchery. Examination of fish in outside ponds in late September indicated almost all ponds had fish harboring the protozoan parasite Costia in varying degrees. As well, one pond had fish severely infected with Gyrodactylus. The parasitized fish were treated successfully with formalin.

Since furunculosis has been implicated as the most important cause of prespawning mortalities in steelhead, some stocks with a disease history are injected with oxytetracycline when the adults are brought into the hatchery. Usually only one injection is required, but a second treatment may be needed if the fish are to be held many months before spawning. Most steelhead held at the Vancouver Island hatchery and Loon Creek hatchery received this treatment, as did the Somass River stock held at Robertson Creek hatchery and the Squamish stock at Fraser Valley trout hatchery. Results of this type of treatment will be assessed in 1984.

Approximately 124,000 cutthroat juveniles were vaccinated against vibriosis prior to release, using a commercially prepared vaccine.

In 1984, the disease agents in parent stocks of cutthroat and steelhead, as well as in juveniles, will be monitored in an effort to have an accurate disease history for enhancement programs. Ideally, the introduction of new diseases into fish culture facilities and natural streams which have no record of such diseases should be avoided.

Contact: Beth Lindvik,
Acting Fish Health Biologist,
Fish and Wildlife Branch,
c/o Pacific Biological
Station, Nanaimo.

Instream Habitat Enhancement

Springer Creek Boulder Placements

Final assessment was made in 1983 on the 1980 and 1981 placements of boulders to increase rearing habitat in Springer Creek. The creek is a tributary of the Salmon River near Sayward on Vancouver Island.

The first boulders were placed in September 1980. Placement of 60 tonnes of boulders over a 450 m length of the creek was undertaken to increase steelhead and coho juvenile rearing capacity. This phase was assessed the following August and it was found that, although salmonid densities had increased, the placements lacked durability; much of the rock had been buried or scattered.

Consequently, in 1981, part of the section was retreated with an additional 15 tonnes of larger (mostly greater than 0.6 m) rock to improve the complexity and durability of the placements.

Further assessments in 1982 and 1983 revealed vastly improved durability with the larger rock and further increases in salmonid densities. Similar results have been obtained in a simultaneous project in Scott Creek near Vancouver.

This was a pilot project over a relatively short stream length, but it indicates the potential for increasing rearing capacity by boulder placements of sufficient size and durability.

It is recommended that these placements be assessed again in August 1986 to test the long-term placement durability and the fish biomass results after five years.

Contact: R.P. (Bob) Griffith,
Fisheries Biologist,
Fish Habitat Improvement Section,
Fish and Wildlife Branch,
Victoria.

Program Development and Bio-economic Evaluation

Regional Planning and Economics Branch

In 1983, a two-year transition phase for the Salmonid Enhancement Program was approved, to follow the major development and construction that had occurred in Phase I of SEP. This two-year program was designed to continue operation of existing facilities while long-term planning for the next stage of development is undertaken. Further funding of enhancement activities will require addressing several concerns about the program, specifically those expressed by the Commission on Pacific Fisheries Policy (the Pearse Commission). The Commission identified the need for integration of enhancement planning with fisheries and habitat management and also pointed to the need for additional monitoring and comprehensive evaluation of Phase I of SEP. This set out the major direction for enhancement planning activities during the transition phase.

Until 1983, advice on program policy and direction for the Salmonid Enhancement Program was provided by SEP's Program Development Branch. However, in response to Pearse's recommendations, the former Program Development Branch and the Regional Economics Group combined to form an integrated planning group called the Regional Planning and Economics Branch. The role of this new branch in planning the next phase of enhancement activities is to prepare, in cooperation with others from SEP, a Cabinet document on SEP continuation by March 1985. In preparation for evaluating SEP Phase I and planning SEP continuation, much work has been done to improve the SEP Production Model that is used to conduct economic analyses of SEP projects and program options. In particular, efforts concentrated on improving and integrating the five accounts and to incorporating risk analysis into the model. Some of the projects that were undertaken include:

a) Study of Salmon Markets

A computerized model that characterizes markets for Canadian salmon products has been developed. It will be used to predict how a variety of possible domestic and international events might affect the industry.

b) Processing Sector Study

A study of fish processing firms in British Columbia was conducted to examine the financial viability of this sector of the industry. The information will be used to calculate the expected economic returns from various government programs that will affect the processing sector.

c) Harvesting Sector Study

A survey of harvesting operations was completed to gather both descriptive and financial data on fishing vessels. This study provides updated information on social and distribution factors in addition to current financial data on the fishing fleet.

d) Processing Distribution

A preliminary study of the distribution of processing activities was conducted. Detailed work is to be undertaken in 1984.

e) Risk Analysis

A major study will identify and quantify the risks associated with the development of enhancement facilities, i.e., the probability of engineering and biological failures.

f) Records of Development Strategies

This project was initiated to document the strategies that were employed when individual projects were initiated. A number of these records were developed in draft form during the year, including: Capilano, Pinkut/Fulton, Meziadin, Pallant/Mathers, Tlupana, Snootli, Kitimat, lower Fraser, Nanaimo, Nitinat/Hobiton.

g) Juvenile Stock Interaction

This project involved a review of available literature and information on the interactions between cultured and wild stocks of juvenile salmonids. The objective was to identify and assess areas of concern to the planning and development of enhancement strategies. A final report will be available by July 1984.

h) Pulse Fertilization

A project explored the merits of using periodic lake enrichment of sockeye rearing areas to place the largest abundances of B.C. sockeye in the Gulf of Alaska at times when ocean abundance will be relatively low. Results will be available in December 1984.

i) Sockeye Stock Selection Criteria

This project compares the magnitude of the effect of ocean sockeye abundance on 26 different sockeye stocks to determine which stocks are least affected by ocean abundance. This information could be one component used in choosing enhancement opportunities. The results will be available in December 1984.

j) Summary of World Salmon Production

This project summarizes data on historic levels of salmon production world-wide, with particular emphasis on production in Pacific Rim countries, and estimates potential levels of future production from both natural and enhanced stocks. The report will be available in September 1984.

k) Biostandards Development

A computer data base containing descriptive biological information on salmonids has been developed. The data include: fecundities, age compositions, lengths, weights, proportions of females, and survival rates from one life stage to the next. The information is categorized by individual stream and enhancement facility location, but information can be retrieved and sorted by any parameter. The project replaces the currently used salmonid survival standards with actual experimental data.

l) Fishway Evaluation

An evaluation of many of the fishways in British Columbia constructed by DFO has been completed. The evaluation depends on a statistical comparison of stream escapements before and after the construction of each fishway to make a number of recommendations on the selection of future sites for the construction of fishways.

m) Coho Production for Expo 86

Anticipating a greatly increased number of visitors to B.C. during Expo 86, the Department undertook an analysis of the impact of increased numbers of sport fishermen. This analysis led to the belief that additional coho production could be used to offset the impact of this additional fishery effort. To this end, approximately, 7.5 million additional coho eggs were taken during the fall of 1983 at hatcheries around the Gulf of Georgia (i.e., Quinsam, Big Qualicum, Chilliwack, and Capilano). About 5 million smolts produced from these eggs will be released in the spring of 1985 and will mature as adults during the summer or fall of 1986. These additional 750,000 adults will help maintain good fishing for all during Expo 86.

Although numerous studies have been completed to improve our knowledge and ability to evaluate some aspects of enhancement activities, the SEP Production Model as it currently exists is not adequate to evaluate all the alternatives for development of Pacific fisheries. The SEP Production Model can perform the economic analysis of a SEP project, but it cannot analyze a management alternative. Since a SEP continuation program must be justified in the context of overall Pacific Re-

gion fishery management policy, the scope of the SEP Production Model needs to be expanded. Fortunately, work on the SEP Production Model dovetails well with the need to create a Regional Planning Model. Incorporating risk analysis into the model requires that it contain a biological component (to forecast run sizes) which is necessary in a model that would be capable of analyzing enhancement-through-management alternatives. Further development of the SEP Production Model to accommodate regional planning requirements will be undertaken by the Regional Planning and Economics Branch in 1984. In addition, a review of SEP Phase I performance will be done once revisions to the model are completed.

Contact: Harold Swan, Associate Director, SEP.

EPIC - SEP Phase I Data Base

EPIC (Enhancement Planning Information Control) is an information management system in a computerized form termed "data base." It was developed to speed data processing in annual planning/evaluation exercises, maintain a centralized and comprehensive summary of program expenditures and salmonid production, and provide maximum flexibility of use to meet changing information demands.

EPIC capabilities include variable access format, nontechnical and user-oriented retrieval language, rapid update mechanisms, input to the economic evaluation model, feedback of analysis results and the potential for expansion or incorporation of new components.

The contents of EPIC are project-specific budget and fish production data, distributed across the life cycle of the projects, plus technology type and site identification data, for all SEP projects and major areas of expenditure.

During 1983, the focus of EPIC activities changed from planning to production performance evaluation. A complete, consistent and centralized source of all SEP Phase I production data became essential. Detailed "brood summary" production data consisting of all egg takes, transfers, juvenile rearing and releases were prepared, reviewed and finalized by the Operations Bio Program group. The Planning Bio Assessment and EPIC Systems groups processed all the information and calculated expected adult production, inputting to the data base and generating a set of reports showing the complete set of data with egg-to-fry and fry-to-release survival rates.

Similar data transfer is underway for lake enrichment juvenile output, provincial trout production and all production of the Special Projects Division. An intensive collection, review and conversion of Community Economic Development, Small Project and Public Participation brood data for input to EPIC will continue into 1984. In addition an in-house microcomputer data base for Community Economic Development project data will be developed along with "uploading" capability to EPIC.

In 1983, EPIC reports were prepared in response to over forty information requests. Fifty percent of these were in support of the Regional and SEP planning activities, thirty percent for senior government and SEP management information requirements, and the remainder for a variety of users within DFO. As well, EPIC reference reports are used to answer numerous ad hoc information queries.

The upcoming priorities for EPIC work are "uploading" from the FISH hatchery data programs to EPIC, revamping EPIC in coordination with the Regional Planning Production Model economic analysis programs, inputting all available data on SEP production returns and contributions to the fishery, and developing "downloading" capabilities to make EPIC data available through Apple microcomputers.

Contact: Rosemary Pogue, A/Systems Coordinator, Enhancement Operations.

Maintenance of Major Facilities

Big Qualicum Project

The water supply tunnel and intake tower were drained and inspected. Additional piles were driven at the intake weir for the chum channel, to raise the water level at low river flows.

Birkenhead River Hatchery

A wedge wire intake screen was provided for the surface water supply. A head tank for Heath trays was built.

Inch Creek Hatchery

The abutments for the collection fence at Blaney Creek were rebuilt. An access road to Stave River was built and a gate was installed in order to assist the Inch Creek hatchery staff to obtain chum brood stock from the Stave.

Chilliwack River Hatchery

The pump from well number 2 was pulled out for repairs.

Babine Facilities

A crane and divers cleaned out the intake at Fulton regulating works. The pipeline tunnel liner and regulating valves were inspected for corrosion. The caretaker's residence was reroofed.

Little Qualicum Project

New aluminum fence panels were designed and built.

Pallant Creek Hatchery

A new crew residence was built.

Puntledge River Hatchery

The left bank diversion fence abutment was fortified with gabions; the discharge pipe for the intake screen was relocated; the aeration tower overflow channel was repaired; a leak in the supply line at the valve was repaired, and the butterfly valve was reconditioned.

At the Tsolum project, a bridge was built over Headquarters Creek to provide more reliable access.

Quesnel River Hatchery

The pumphouse cooling system was repaired.

Quinsam River Hatchery

A jib crane was installed for intake screen removal. Air release valves on the intake pipeline from Cold Creek were exercised and inspected, and underground drainage piping for marking lab discharge was installed.

Robertson Creek Hatchery

The intake screen was repaired; head troughs in the incubation room were replaced, and a septic system for the residence at the gate was supplied.

Snootli Creek Hatchery

A snow shelter was built between the rearing ponds and keeper building, and an electrical system for the tank farm was installed.

Conuma River Hatchery

Building number 1 was raised; a storage building and car port were built; the access road to the river was improved; an alarm system to the aeration tower was installed, and the well houses were enlarged.

Contact: John Beyer, Senior Engineering Technician, Engineering.

FISH Microcomputer System

The development of a computerized data management system for hatcheries has been underway since 1980. The system operates on Apple II microcomputers and utilizes a package of programs known as FISH (Fishculture Information System for Hatcheries). These programs were developed by Enhancement Operations biologists and are now complete.

The FISH program package consists of data management programs for juvenile and adult fish, and utility programs for statistics, modelling fish growth, calculating gas solubility and other hatchery applications. There is also a comprehensive disease treatment program whereby the user can select any of 24 different fish diseases for which the program will supply suitable treatments, notes on treatment chemicals and calculations necessary for the administration of correct dosages.

There are now 13 hatcheries in B.C. equipped with microcomputers, with plans to purchase and place three more Apple II microcomputers in 1984. Training sessions and custom programming are ongoing at each facility. Extensive documentation for both system users and programmers has been prepared and will be published in 1984.

Contact: Anne Kling, Bio Program System Administrator, Enhancement Operations.

Surplus Egg and Fish Sales

There were record surplus adult sales and egg/juvenile sales from major facilities in 1983. Total value of surplus sales (as supplied by Crown Assets Disposal Corporation) was $68,397.81.

Egg/juvenile sales totalled 4,281,000 of which 2,619,000 were sold to aquaculture firms for a revenue of $28,060. The remaining 1,662,000 eggs were supplied free of charge to public involvement and community economic development programs as well as for research purposes.

A total of 41,676 coho and chum adults and jacks were supplied from Big Qualicum to the Qualicum band.

Contact: Don Bailey, Assessment Biologist, Enhancement Operations.

Feed Quality Control Program

Enhancement Operations, in cooperation with the West Vancouver Laboratory nutrition research group, continued to operate the fish feed quality control program in 1983. The program is designed to allow sampling of ingredients and finished feed at the production site, with subsequent chemical analysis in Vancouver and rapid feedback of results. Analysis was carried out under contract by Can-Test Ltd. and Quanta Trace Laboratories.

An effort was made to sample all feed destined for B.C. hatcheries at the manufacturing site, with samples of the component herring meal and fish oil also taken. Each contract laboratory received a portion of all samples taken. A duplicate of each sample was stored at the West Vancouver Laboratory in order to create a reference sample set for cross-checking and further analysis if necessary.

Chemical analysis results of critical quality control parameters were supplied within four to seven days of sample delivery. Detailed analysis results were available within 10-14 days. If parameters were within acceptable limits, the food batch in question was then cleared for use. Any feed batches of doubtful quality were retested and, depending on analysis results, not fed at all or fed in only limited quantities. All results (including some basic statistical analysis) were stored in an Apple computer program.

The benefits of the program are twofold. First of all, it has allowed biologists to monitor feed quality and highlight problems when necessary. Second, the collection and examination of analysis results has permitted the refinement, and in some cases, establishment, of appropriate parameter specifications.

The program will be continuing in 1984.

Contact: Carol Cross, Assessment Biologist, Enhancement Operations; Jack Markert, Chemist, Fisheries Research Branch.

Supersaturation Research Programs

High levels of gas supersaturation are recognized as a serious environmental problem. Total Gas Pressure (TGP) levels of over 110 percent can cause gas bubble formation in the blood and

tissue of salmonids. Such bubble formation often results in:

- tissue damage (bubbles form between fin rays, in the roof of the mouth, etc.)
- eye damage (excessive gas pressure behind the eye results in exophthalmia)
- equilibrium problems (due to rupture of the swim bladder)
- and/or sudden death (due to emboli in the heart).

These dramatic effects are usually associated with high TGP levels (such as those that occur on the Columbia River).

The response of salmonids to lower levels of supersaturation (such as often occur in fish culture operations) is more subtle and difficult to quantify.

Chronic exposure to low levels of supersaturation may be related to a number of common fish health problems; effects are probably linked to a complex web of physical and biological factors. These factors probably include:

- fish size (fry are more sensitive than adults)
- species
- presence of pathogens
- water depth
- temperature
- water hardness
- TGP level
- nitrogen level
- the presence of other stressors
- exposure time.

In British Columbia this problem is presently being attacked in four ways.

First, a research contract has been established to investigate the biophysical principles involved in both the transfer of excess gas from the environment to the fish and in the growth of bubbles within the tissue and blood. This work will lead to a theoretical model relating biological effects to various environmental factors. It must be pointed out that such a theoretical model can only provide an approximate, qualitative understanding of biological response.

Second, experimental work will be carried out at Pacific Biological Station, Nanaimo. The insights provided by the theoretical model will be used in the design of the experiments. The experimental work should allow more precise quantification of relationships between biological response and the web of environmental factors related to gas bubble trauma. This work should also increase understanding of stock, species and life stage sensitivity.

Third, an experiment is being performed at the Puntledge River hatchery to measure the benefits of aeration to a large-scale chinook rearing operation. The water supply to one set of troughs is being aerated for the removal of excess nitrogen gas while another set of troughs is supplied with untreated water. The effects will be observed over the 120 day chinook rearing period. This experiment is being monitored through a research contract.

Fourth, supersaturation levels within SEP facilities will be monitored. These data will show what levels of supersaturation eggs and fish are presently being exposed to in SEP facilities.

This approach should lead to a much better understanding of the biological response to supersaturation. This understanding is required for the rational planning of aeration devices for new or existing facilities. Even with the limited work to date, it is clear that meaningful supersaturation criteria depend on:

- life stage (alevin incubation and fry early rearing require more stringent criteria than later rearing)
- availability of water depth (fish with greater availability of water depth can tolerate higher TGP levels)
- movements from deep to shallow containers (more stringent TGP criteria must exist where fry emerge from deep incubators to shallow rearing containers)
- water temperature and hardness (supersaturation is more detrimental at higher temperatures in soft water).

The insights gained through this work should find direct application in many existing and future fish culture operations.

Contact: Bill McLean, Enhancement Support Biologist, South Coast Unit.

Salmon Services

The Salmon Services and Special Projects Unit receives funding from both FSB and SEP to conduct the province-wide Mark Recovery Program and the Regional Scale Laboratory (fish ageing service). Technical assistance to the Mark Recovery Program is also being provided by the Fisheries Research Branch under a joint cooperative program initiated in 1983. The Scale Laboratory and the Mark Recovery Program collect data on the size and age of salmonids and recover coded-wire tags, Petersen disc and Floy tags and fin marks from B.C. salmonid fisheries. The unit also participates in commercial and sport logbook programs, coordinates the purchase and supply of coded-wire tags for marking, coordinates the reporting of coded-wire tag and fin-clip release information to the Pacific Marine Fisheries Commission and coordinates and processes recovery information for Petersen disc and Floy tagging projects.

Mark Recovery Program

a) Coded-wire Tag and Fin Mark Sampling

The Mark Recovery Program attempts to sample 20 percent of all B.C. commercial salmonid fisheries for fish carrying coded-wire tags (identified by a missing adipose fin), dissects the heads from marked fish to recover the tags, and decodes the tags. Selected fisheries are sampled for fin-marked fish (identified by the absence of fins other than the adipose).

In 1983, commercial catches of chinook, coho, steelhead, and chum were sampled at processing plants in Prince Rupert, Namu, Port Hardy, Tofino, Ucluelet, Vancouver, Steveston and within Georgia Strait. A total of 962,200 fish was sampled, with 17,728 heads collected from adipose marks and 556 fin-clips recorded. These numbers show a 25 percent decrease in the numbers sampled over 1982, reflecting decreased catches of chinook and chum. The incidence of marked steelhead increased dramatically, especially in Barkley Sound, where a mark incidence of 65 percent was recorded. The majority of the chum coded-wire tags were recovered in statistical areas 3X and 3Y, and originated from Nakat Inlet, Alaska.

During 1983, 10,638 heads of sport caught salmonids were voluntarily turned in by fishermen to the 170 head depots located at boat docks, tackle shops and DFO offices throughout B.C. The number of heads recovered increased in 1983 (up 25 percent over 1982), especially for coho from the upper Fraser Valley, which noted a marked increase due to increased production from the Chilliwack and Chehalis hatcheries. Five depots set up in the Queen Charlotte Islands may increase the number of marks recovered from northern regions.

Sport fishermen who turn in the heads of adipose-only clipped fish receive information on the origin of their fish and a Mark Recovery Program button. They are also eligible for one of eight prize draws for one $500 prize and six $50 prizes.

In addition to the dissection and tag reading of commercial and sport recoveries, the Head Recovery dissection laboratory provides support to other fisheries projects by processing heads from escapement steelhead, chinook and coho. For the second year, support was also given to research groups by processing smolts from an enumeration project in the Quinsam estuary. Heads were also processed from a shaker study, a troll observer program and from incidental chinook recoveries from trawlers.

Data collected by the MRP was processed by computer on an on-line entry

system. Throughout 1983, in-season reports were distributed to provide users with up-to-date information. The 1980 and 1981 annual reports were printed and distributed, and a preliminary 1982 annual report produced. A sport bulletin was written and distributed to all interested anglers.

A user-accessible base is being developed for access to MRP data for all years. Major changes in entry programs and user reports are expected, and it is anticipated that MRP data will be more timely and accessible to users. The 1982 annual report will be published and the 1983 annual report readied. The 1983 sport bulletin will be distributed.

b) Biological Sampling

The biological sampling program is executed by the MRP under the direction of the regional chinook and coho biologist. Additional support was supplied by the Summer Student Youth Employment Program. In 1983, chinook, coho and chum were sampled for scales, lengths and weights. Steelhead samples were not taken due to the large number (70 percent) of regenerate scales noted in 1982.

The scales collected are read by the Regional Scale Laboratory. The data provided age information on commercially caught chinook and are added to the laboratory's library of scale information.

c) Petersen Disc and Floy Tagging

The MRP coordinates information from Petersen disc and Floy tagging programs. Files are kept on each tagging project, recording where and when the tagging was done, the study purpose, the species tagged and the numbers tagged. Fishermen who return the tags are notified of prize draws and rewards (if applicable) and are informed of the project for which their tags were applied. Returned tags and recovery information are forwarded to the biologists involved in the projects.

The second year of the International Salmonid Tagging Program (ISTP) was undertaken during 1983. The program objective is to estimate the interception rates of southeastern Alaska and northern B.C. sockeye stocks by Alaskan and Canadian fishermen, but information on migration paths, timing and escapement will also be revealed. Over 23,000 sockeye were tagged with bright red (international orange) Petersen disc tags. In addition 5,700 chum, 770 chinook and 35 steelhead caught incidentally were tagged.

Voluntary returns of tags by fishermen plus recovery of tags during sampling of the catch and escapement are expected to exceed 8,500 tags in Canada alone, with reported recoveries from Prince William Sound south to the Fraser River. Tags returned by fishermen who also reported the recovery location, date and gear type were entered into three lotteries. The final draw was held October 7, with two $2,500 prizes awarded. The MRP sampled net catches from Sabine Channel and Johnstone Strait for ISTP tags. There were 15 tags recovered from sampling 62,118 sockeye. Sampling was also conducted by the ISTP.

During the 1983 program, an alternative tag type was tried. The tag was an orange plastic tube approximately one foot long (Floy spaghetti tie-on tag). About 300 of these tags were applied during the program, alternating the application of one tie-on tag with the application of a Petersen disc. Recoveries from catch sampling and at the Babine Fence indicate that this alternate tag has a recovery rate three times that of the Petersen disc tag, with 75 percent of the applied tags recovered. This tie-on tag has great potential as a replacement for disc tags, which are notorious for damage to gill nets.

Other 1983 tagging projects include Petersen disc tagging of sockeye in the Nimpkish estuary, mixed species in Knight Inlet and Burke Channel, chum in the Mission area, chinook in the Tête Jaune River and coho in the Chilliwack, Salmon and upper Pitt Rivers. Several other studies applied unnumbered Peter-

sen baffles, for which returns are not required. These unnumbered tags are usually used in making escapement estimates.

Unless it is prohibited due to fiscal restraint or cancelled due to a lack of U.S./Canada agreement on salmon interceptions, the tagging program will be continued in 1984. Pink and chum will be the species studied in detail. Sockeye interceptions will likely be continued, using biological markers (parasites, scale patterns and/or electrophoresis). Other proposed projects include tagging of Shuswap River chinook, upper Pitt River coho, mixed species in Burke Channel and Nekite River, and the continuation of Nimpkish sockeye tagging.

The MRP office stores an inventory of discs, pins, washers and baffies that are available on request, as well as addressed, postage-paid envelopes for the return of tags.

Contact: Vic Palermo, Biometrician/Programmer; Margaret Birch, Acting Chief, Salmon Services.

Fish Morphology Laboratory

The fish morphology laboratory conducts ageing analysis for all species of salmon and certain freshwater fish. Scale samples are mainly used, along with otoliths (ear-bones) and fin rays when resorption is a factor in obtaining total age (sockeye and chum).

The total number of scale samples for 1983 received in the lab, to February 2, 1984 was 389,200. This includes a number of late samples (21,100), which arrived after December 31, 1983. The total number of scales received in 1982 was 410,080 - indicating a drop of approximately 20,880 this year.

a) Court Cases

The scale laboratory provides expert testimony in Fisheries court cases. Each case was supplied with a detailed scale analysis and report as well as photographs of the scales. In 1983, court appearances were made in Prince George, Golden, Ashcroft, Williams Lake, Kamloops, 100 Mile House and Stoney Plains, Alberta.

b) Education

The Spruce City Wildlife Association sports and outdoor show took place in Prince George over a three-day period in April 1983. The scale laboratory provided a display including salmonids and steelhead, and instruction on ageing by scales, fins and otoliths. This generated much public interest.

The scale laboratory also provided information to the Chilliwack High School regarding construction of a field scale press to be used in school classrooms for biology courses, and provided training for a student from BCIT.

c) Otoliths and Fin Rays

The number of otoliths received in the laboratory from 1983 sampling was 2,156. This year otoliths were analyzed from eulachons, rainbow trout and mountain whitefish, as well as salmon. The number of fin rays received was approximately 1,100.

One of the highlights of the 1983 scale ageing was the correct identification and ageing of an eight-year-old chinook (adipose-clipped) caught in Namu.

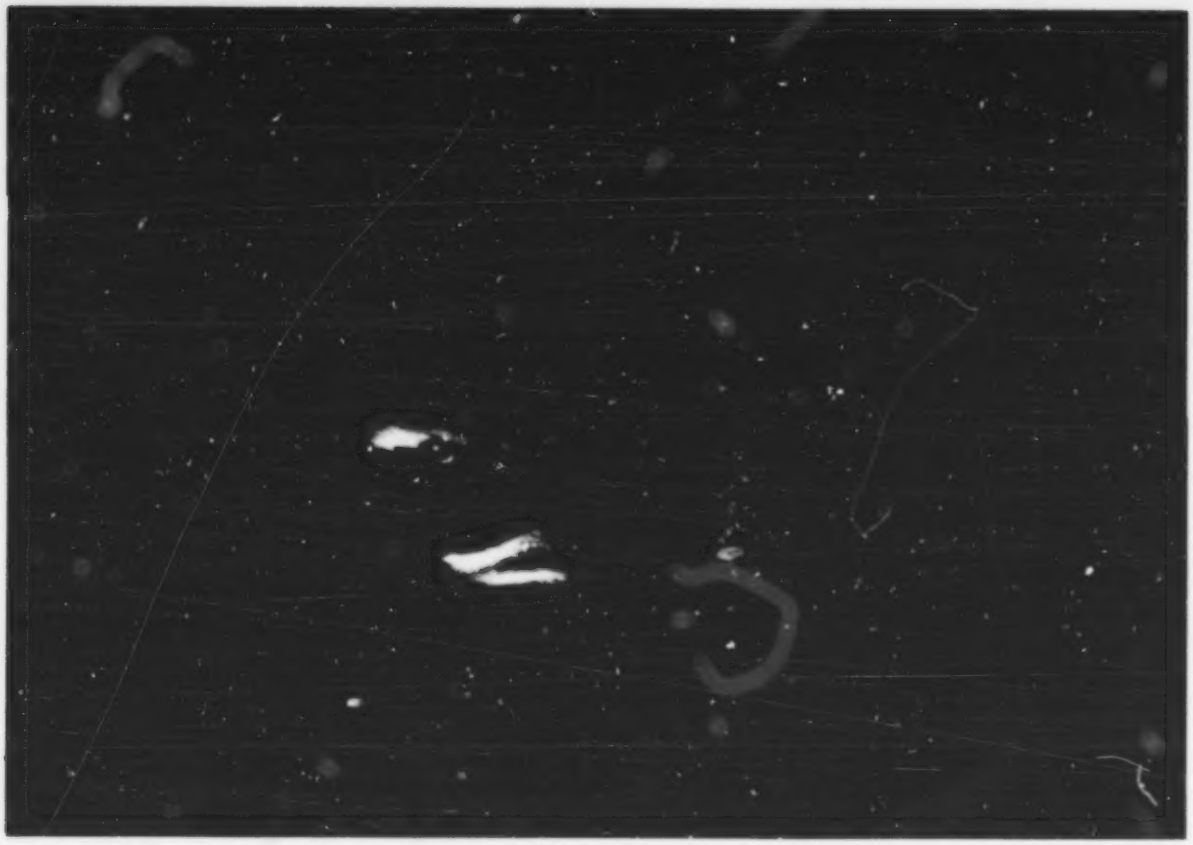
Contact: Yvonne Yole, Scale Laboratory.

Fieldwork Bulletin

SEP Enhancement Operations, Habitat Management, and Field Services jointly supported an initiative of Glover Business Communications Ltd. to produce a pilot "Fieldwork Bulletin" in 1983. The purpose of the Bulletin was to share information about planned, ongoing or recently completed fieldwork, in order to reduce duplication of effort and allow cost-sharing or "piggybacking" of studies. Although obtaining the information was somewhat

difficult, the first issue was well-received, and a second issue was undertaken following one of the recommendations arising from the evaluation. Unfortunately, obtaining the second lot of information was no easier than for the first issue. The general response after the second issue was that it was generally useful, but no cost savings could be demonstrated nor did any group wish to commit further funding. The project therefore was terminated.

Contact: Bruce Shepherd,
New Projects Coordinator,
Enhancement Operations.



Program Direction & Communications

1. *The Roderick Haig-Brown memorial Trophy was awarded to "Salmonid" magazine for 1983 in recognition of its efforts to further public appreciation of our fishery resource.*

Program Direction and Communications

Salmonid Enhancement Board

In August 1978, the federal Minister of Fisheries and Oceans, in consultation with the provincial government, established the Salmonid Enhancement Board to provide him directly with advice and recommendations concerning the management and direction of the Program.

The Board is the senior advisory group for the Program and its membership consists of 12 representatives from the federal and provincial governments and from the private sector. Private-sector appointees represent the interests of commercial and recreational fishing, native people, the forest industry and the public at large.

Three meetings of the Board were held during 1983 including a joint meeting with the Salmonid Enhancement Task Group. The Board attended the opening of the Goldstream hatchery operated by the Amalgamated Conservation Society.

The Board at its meetings in 1983 concentrated on an examination of the planning which led to the Transition Phase of the Salmonid Enhancement Program. It concluded that the two-year term would be in line with the Pearse recommendations which suggested a review and analysis of the Program to date prior to seeking approval for the continuation of the Program.

Contact: Pam MacKenzie, Secretary to the Salmonid Enhancement Board.

Salmonid Enhancement Task Group

The Salmonid Enhancement Task Group (SETG), the primary public advisory group to SEP, provides the views and advice of a broadly-based, nongovernmental group on matters which are within the responsibility of SEP. The SETG represents the general public and resource user groups through its membership. It reports to the Salmonid Enhancement Board.

Members on the SETG include representatives of commercial and sport fisheries, the processing industry, mining, forestry, tourism, B.C. Hydro, municipal governments, education, Consumers' Association of Canada, conservationists, media, and taxpayers. (See Appendix D for list of current members.)

In 1983, the Task Group's budget was reduced considerably. As a result, only two full-group meetings were held, both in Vancouver.

At the annual joint SETG/Board meeting in May, the Task Group examined the Transition Phase plans. Committees were formed; they prepared reports on cost recovery, a federal-provincial agreement, and SEP/DFO integration.

In October, the Task Group dealt with:

- integration of SEP into Pacific Region; the SETG supported it
- SEP budget for 1984/85 fiscal year; the SETG was concerned that new initiatives would have to wait for at least two years
- proposed Kemano Completion project; the SETG expressed its concern over potential loss of salmonid habitat and production.

Following the October meeting, the SETG prepared a scorecard which evaluated Phase I of SEP relative to the five accounts and the public inquiries (held in 1976 and '78/79). Results included:

- high marks for the education, information, and public involvement components of SEP
- average ratings for habitat protection and rehabilitation
- low marks for fisheries management and enforcement.

Late in the year, a committee examined a DFO discussion paper outlining a proposed national fish habitat management policy. The committee met with the chief of the Habitat Management Branch (Ottawa) and emphasized the need for habitat protection based on a strong no-net-loss principle.

For 1984, the Task Group plans to continue working for a SEP Phase II which will reflect the wishes of the public.

Contact: Doug Aberley, Chairman,
Salmonid Enhancement Task Group.

SEP Information Program

One of the objectives outlined in the original plan for SEP was "to increase the community awareness of the problem of salmonid's survival. to inspire awareness of solutions to these problems, and to strengthen the role of the public in helping to conserve the salmonid resource and its habitats." This need was to be met through a variety of educational and informational activities directed at school students, user groups and the general public. Activities in 1983 continued to provide components of this program.

In 1983, partially in response to recommendations contained in the Pearse Report, a decision was taken to cease publication of "Salmonid" with the April, 1984 issue. For the past eight years, this very popular magazine has reported on SEP activities and informed the public and user groups on a wide variety of issues which affect the resource. During 1983, four issues were published, including a special issue for children in February entitled "Discovering Salmonids" and "How Does SEP Measure Up?" in December. The latter issue presented an accounting of SEP's first seven years.

Although publication of "Salmonid" has been terminated, news of interest to its audience is to appear in a new, integrated fisheries magazine. "Salmonid" performed well as a communication vehicle, however, and its efforts in presenting the case of the fisheries resource to the general public was recognized early in 1984 when it was presented with the prestigious Roderick Haig-Brown Memorial Award from the American Fisheries Society, North Pacific International Chapter.

SEP also printed 30,000 copies of "When and Where to See Salmon" during 1983. Other information activities included use of the SEP display at several locations around the province, and the installation of informational displays at Chilliwack, Puntledge and Chehalis hatcheries.

An audio-visual presentation "Putting a Little Back" was completed early in 1983. This slide tape describes SEP's volunteer projects. Also dealing with visual material, SEP maintains an extensive library of slides depicting the resource. This material is of great value in publications and for audio-visual presentations.

As well, a large annual report, the equivalent of this volume, was produced in 1983, covering SEP activities in 1982. This report provides detailed information on each SEP project, while its companion piece, the summary annual report, provides an overview of each year's activities. A French version is also available on request.

Contact: James Boland,
Head,
Public Involvement Unit.

Educator's Package

The SEP educational coordinator has four major responsibilities:

- writing and editing material for the curriculum package Salmonids In The Classroom
- conducting in-service sessions for users of the package materials
- providing input to the development of SEP information materials
- maintaining liaison between DFO staff and the educational community.

During 1983, the coordinator was primarily responsible for the development and editing of a special education package to be used in the classroom by fishery officers and other staff of DFO. Also, workshops introduced the new version of the Educator's Package, edited from seven volumes to two. These new single volumes (one for elementary and one for secondary classes) include lesson plans, student activity sheets, overhead transparencies, reference material, an audio-visual catalogue and student evaluation suggestions.

Eighteen teachers throughout B.C. assisted in the further development and field testing of the primary (kindergarten to grade three) component of Salmonids In The Classroom. The educational coordinator conducted several joint working sessions with the teachers who were testing these materials to refine and rework the package. This new component should be ready for introduction to schools in November 1984.

Contact: Linda Bermbach, Educational Coordinator; James Boland, Head, Public Involvement Unit.

Appendices

A. SEP Fish Production, Forecast Catch and Production Capacity

Summary of 1983 SEP Fish Production*

Species	Juveniles Released	Expected Adult Production
Sockeye	171,882,425	3,086,950
Chum	119,131,159	1,900,719
Pink	2,933,339	83,939
Coho	10,446,723	871,644
Chinook	25,022,718	992,299
Steelhead	2,196,244	55,645
Cutthroat	94,121	7,889
TOTAL	331,706,729	6,999,085

*Includes production from all SEP facilities and projects, and lake enrichment.

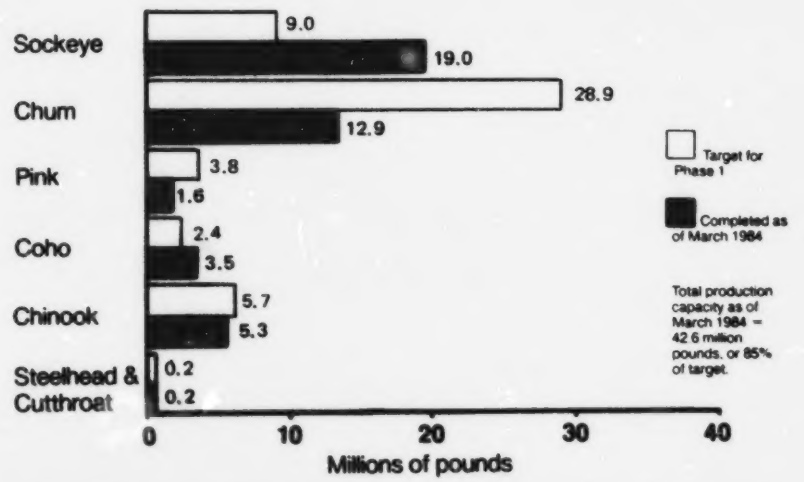
Forecast Catch from Existing SEP Projects* at Design Capacity**

Species	Canadian Catch Pieces	Canadian Catch Pounds
Sockeye	3,985,127	22,809,696
Chum	1,221,453	14,162,920
Pink	471,843	2,024,374
Coho	956,147	4,810,249
Chinook	875,898	7,744,838
Steelhead	27,132	279,244
Cutthroat	14,656	7,329
TOTAL	7,552,256	51,838,650

*Projects constructed before SEP as well as SEP projects which are completed as of 1983/84 fiscal year.

**Projected Canadian commercial, sport and native food fish catches, each year.

SEP Production Capacity by Species: Phase 1 Targets and Performance to Date*



*Production capacity measures the capacity of facilities which have been constructed since 1977 (SEP facilities only) and are now operational. The capacity is stated in terms of expected future adult catches, using current facility capacities, current expected egg to adult survival rates of enhancement techniques, and projected future Canadian catch rates.

B. *Financial Statements*

SEP Expenditures by Program Area (in Thousands of Dollars)

	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84
Program Area							
Major Production Projects	$1,621	$ 6,754	$11,974	$12,847	$12,897	$ 9,715	$ 3,455
Minor Production Projects	252	726	1,098	1,461	1,212	1,211	1,188
Pilot Production Projects	283	284	135	244	181	383	211
Facility Operations/Maintenance	1,344	2,803	3,820	5,777	8,150	9,345	11,711
Community Development Projects	453	1,929	2,813	3,168	2,959	3,672	3,746
Lake Enrichment	307	676	1,095	1,345	1,454	1,801	1,874
Public Involvement	505	829	830	874	1,051	1,278	1,234
Reconnaissance/Feasibility Studies	1,581	754	1,508	1,588	990	394	305
Manageability/Environmental Studies	764	1,725	1,267	1,488	730	567	560
Evaluation/Assessment Studies	354	608	157	402	332	294	320
Research Studies	459	461	644	691	396	718	544
Program Planning and Direction	791	1,032	1,196	1,633	775	1,361	813
Provincial Program (Federal Share)	364	865	688	744	376	460	417
Provincial Program (Provincial Share)	264	289	1,243	1,250	1,250	1,250	1,250
TOTAL	$9,342	$19,735	$28,468	$33,512	$32,753	$32,449	$27,628
Source of Funds							
SEP Phase I	$7,878	$17,146	$24,735	$28,462	$26,911	$26,000	$18,800
DFO* Contribution	1,200	2,300	2,500	3,800	4,592	5,199	7,578
Provincial Share	264	289	1,243	1,250	1,250	1,250	1,250
TOTAL	$9,342	$19,735	$28,478	$33,512	$32,753	$32,449	$27,628
Phase II Program Development	—	—	—	—	$ 2,466	$ 1,496	$ 1,484

*Dept. of Fisheries and Oceans.

Enhancement Operations and Maintenance

Project	Amount
Enhancement Ops. Admin.	$1,030,900
Quesnel	635,000
Inch Creek	601,400
Chilliwack	686,300
Chehalis	525,700
Tenderfoot	264,800
Jones Creek	8,900
Birkenhead	78,200
Capilano	473,300
Eagle (S. Thompson)	283,100
Big Qualicum	666,700
Little Qualicum	362,600
Puntledge	804,400
Chemainus	120,500
Tlupana Inlet	498,600
Nitinat	563,100
Quinsam River	717,700
Robertson Creek	719,300
Snootli Creek	507,700
Fulton River	419,100
Kitimat River	470,200
Pinkut River	325,200
Pallant Creek	552,800
Maintenance - General	376,600
Kakweiken Maintenance	18,900
Total	**$11,711,000**

Minor Production Projects

Project	Amount
Small Project Administration	$ 707,900
Stream Catalogue	37,300
General Support Engineering	17,100
CEDP Support	130,500
Stream Rehabilitation	44,200
Kanaka Creek	4,200
Little Mountain Slough	1,100
Alouette River	23,400
Chilliwack	1,700
Peach Creek	4,000
Westholme Channel	3,900
Vancouver River	16,000
Coates River (QCI)	1,500
Copper River	9,600
Embley	52,400
Koeye	132,800
Total	**$1,187,600**

Public Involvement

Project	Amount
Secretariat	$ 18,200
P.I. Administration	561,700
Administration Acting	4,200
Information Administration	146,800
Annual Report	64,600
Public Education	47,900
Public Participation	44,700
SEIG Public Advisory	6,100
Kamloops Community Advisor	42,100
New Westminster Community Advisor 1	39,400
New Westminster Community Advisor 2	26,700
Sechelt Community Advisor	42,900
Nanaimo Community Advisor	30,000
Victoria Community Advisor	35,200
Port Hardy Community Advisor	45,900
Terrace Community Advisor	40,300
Queen Charlotte Community Advisor	36,500
Total	**$1,233,200**

Major Production Projects Design and Construction

Project	Amount
Engineering Management	$1,641,300
Tenderfoot	184,600
Kitimat	1,362,300
Eagle	24,400
Inch	165,200
Chehalis	77,000
Total	**$3,454,800**

Pilot Studies

Project	Amount
Penny	$ 66,300
Kitsumkalum	9,100
Mathers	135,400
Total	**$ 210,800**

Reconnaissance / Feasibility

Project	Amount
New Project Administration	$ 153,100
Water Quality	43,000
Engineering Reconnaissance	109,000
Total	**$ 305,100**

Program Planning and Direction

Project	Amount
Executive Director	$ 145,500
S.E.P. Board	9,100
Native Trainees	2,400
Financial Administration	258,400
Director Operations	80,900
Administration Biology	247,500
Method Review and Evaluation	5,800
Program Evaluation	18,800
Regional Planning	45,100
Total	**$ 813,500**

Evaluation and Assessment

Project	Amount
Direction	$ 40,000
Five Account Evaluation	9,300
Recreation Studies	5,800
Enhancement Management	11,200
MC, Capital and Ex Post	79,600
License Values	12,000
Risk Analysis	44,200
Systems - Support	7,800
PM Development	2,900
EPIC and PM Operations	65,900
Program Development Data	7,500
Biostandards Data Base	22,500
Apple Purchase and Maintenance	2,400
Catch Statistics - Economic	8,900
Total	**$ 320,000**

Manageability and Environmental Impact Studies

Project	Amount
Fraser Management	$ 62,600
Mark Recovery	497,500
TOTAL	**$ 560,100**

Provincial Programs

Project	Amount
Headwater Stocking	$ 10,000
Steelhead Habitat Assessment	100,00
Chilco Fry Stocking	76,800
Thompson Steelhead	79,800
Skeena River Steelhead	150,300
Total	**$ 416,900**

Research

Project	Amount
Program Support	$ 68,000
Stress and Histophysiology	36,500
Hatchery Incubation	68,300
Time and Size Release	63,200
Smolt Requirements	10,800
Control Reproduction	47,600
Nutrition	63,000
Disease Control	5,300
Diagnostic Services	98,700
Salmon Genetics	82,800
Total	**$ 544,200**

Lake Fertilization

Project	Amount
Program Management	$ 91,900
Juvenile Ecology	109,300
Adult Ecology	14,200
Survey and Research	51,400
Phytozoa Dynamics	4,900
Treatment	1,074,100
Monitoring	529,100
Total	**$1,874,900**

Community Economic Development

Project	Amount
Administration	$ 440,800
Previous Year Claims	1,800
Water Sampling	1,600
Tagging	24,700
Project Advisors	492,600
Klemtu	25,000
Hartley Bay	23,000
Skidegate	17,200
Kitsumkalum	21,700
Oweekeno	6,000
Fort Babine	21,100
Nuu-Chah-Nulth	900
Chehalis	170,300
BCIT	112,000
Cen. Inter. Trib. Coun.	122,100
North Thompson	115,700
Nanaimo	258,300
Cowichan	223,200
Sliammon	175,300
Sechelt	200,100
Thornton Creek	107,600
Port Renfrew	94,700
Nimpkish	264,800
Bella Bella	219,700
Kincolith	123,600
Kispiox	271,000
Masset	211,400
Total	**$3,746,200**

C. *Salmonid Enhancement Board — List of Members*

A.W. (Art) May (Chairman)
Deputy Minister
Department of Fisheries and Oceans
240 Sparks Street
Ottawa, Ontario
K1A 0E6

D. (Doug) Aberley
Chairman, Salmonid Enhancement Task Group
2 - 1719 Yew Street
Vancouver, B.C.
V6K 3E8

E.A. (Earle) Anthony
Assistant Deputy Minister
Environmental Management Division
Ministry of Environment
Parliament Buildings
Victoria, B.C.
V8V 1X4

C. (Cliff) Atleo
Native Brotherhood of British Columbia
Main Floor
788 Beatty Street
Vancouver, B.C.
V6B 2M1

J.B. (Bruce) Buchanan
President
British Columbia Packers Ltd.
Post Office Box 5000
Vancouver, B.C.
V6B 4A8

W.G. (Gerry) Burch
Vice-President
Timberlands and Forestry
B.C. Forest Products Ltd.
1050 West Pender Street
Vancouver, B.C.
V6E 2X3

H. (Howard) English
6470 Rey Road
Victoria, B.C.
V8Y 1V2

Dr. W.E. (Wally) Johnson
Chairman, F.O.R.A.C.
Department of Fisheries and Oceans
6640 North West Marine Drive
Vancouver, B.C.
V6T 1X2

B.E. (Ben) Marr
Deputy Minister
Ministry of Environment
810 Blanshard Street
4th Floor
Victoria, B.C.
V8W 2Y5

G. (George) Olafson
653 - 11th Avenue East
Prince Rupert, B.C.
V8J 2W6

R. (Ray) Phillips
Madeira Park Post Office
British Columbia
VON 2H0

G.C. (Gary) Vernon
Assistant Deputy Minister
Pacific & Freshwater Fisheries, DFO
240 Sparks Street
Ottawa, Ontario
K1A 0E6

Exofficio Members

Dr. N. Ward Falkner
Executive Director
Salmonid Enhancement Program
Department of Fisheries and Oceans
1090 West Pender Street
Vancouver, B.C.
V6E 2P1

C.W. (Wayne) Shinners
Director General
Department of Fisheries and Oceans
(Pacific Region)
1090 West Pender Street
Vancouver, B.C.
V6E 2P1

D. *Salmonid Enhancement Task Group — List of Members*

Member	Affiliation	Member
SETG Executive:		
Doug Aberley (Chairman) 2 - 1719 Yew Street Vancouver, B.C. V6K 3E8	Local government	Bill Jarvie 857 East 32nd Avenue Vancouver, B.C. V5V 2Y7
Don Bennison (Vice Chairman) 3236 Archibald Place Kamloops, B.C. V2B 8B2	Education	**Mike Burgess** Fisheries Council of B.C. #400 - 100 W. Pender Stree Vancouver, B.C. V6B 1R8
Membership:		Harvey Wright Fisheries Council of B.C. #400 - 100 W. Pender Stree Vancouver, B.C. V6B 1R8
Robert Marcellin #9 - 4644 Lazelle Terrace, B.C. V8G 1S6	Local government	**Len Bell** B.C. Hydro Resources Engineer Box 12121 555 W. Hastings Street Vancouver, B.C. V6B 4T6
Larry Burroughs P.O. Box 265 Port Hardy, B.C. V0N 2P0	Education	Bob Ferguson B.C. Hydro Aquatic Ecology Supervisor Box 12121 555 W. Hastings Street Vancouver, B.C. V6B 4T6
Don McDermid 2255 Windridge North Vancouver, B.C. V7H 1B6	B.C. Federation of Fly Fishers	
Tom Murray 1975 Russet Way West Vancouver, B.C. V7V 3B3	B.C. Federation of Fly Fishers	**Tom Russell** Box 67 Coal Harbour, B.C. V0N 1K0
Bruce Ott Placer Development 1500 - 1055 Dunsmuir Street Vancouver, B.C. V7X 1P1	Chamber of Mines	David Elliott 625 - 5960 No. 6 Road Richmond, B.C. V6V 1Z1
Edgar Birch 11660 - 98A Avenue Surrey, B.C. V3V 2K9	United Fishermen & Allied Workers Union	

ffiliation	Member	Affiliation
United Fishermen & Allied Workers Union	**Ken Stenerson** Scott Paper Ltd. Box 760 New Westminster, B.C. V3L 4Z9	Council of Forest Industries
Processors	Phil Gilbert #1500 - 1055 W. Hastings Vancouver, B.C. V6E 2H1	Council of Forest Industries
Processors	**Marietta Duxbury** 988 East 16th Avenue Vancouver, B.C. V5T 2V9	Consumers' Assn. of Canada
B.C. Hydro	Ruth Lotzkar 7195 Selkirk Street Vancouver, B.C. V6P 6J4	Consumers' Assn. of Canada
	Richard Martinolich 5104 45th Avenue Delta, B.C. V4K 1K5	Vessel Owners' Assn.
B.C. Hydro	Gerald Dobrilla 4557 Savoy Street Delta, B.C. V4K 1P4	Vessel Owners' Assn.
	Nancy Marshall P.O. Box 37 Delta, B.C. V4K 3N5	Prince Rupert Fishermen's Co-op
Pacific Trollers Association	Ken Monroe 3200 Indian River Drive North Vancouver, B.C. V7G 1L3	Prince Rupert Fishermen's Co-op
Pacific Trollers Association	**Sandy Ross** 655 Naramata Road R.R. #1 Penticton B.C. V2A 6J6	Taxpayer

Member	Affiliation
Ken Glover 701 - 5652 Patterson Av Burnaby, B.C. V5H 4C8	B.C. Wildlife Federation
Don McDonald 1747 Draycott Road North Vancouver, B.C. V7J 1W5	B.C. Wildlife Federation
Eric Carlisle 1095 Inglewood Avenue West Vancouver, B.C. V7T 1Y1	Steelhead Society of B.C.
Barry Thornton 1841 Robb Avenue Comox, B.C. V9N 4S4	Steelhead Society of B.C.
Alex Whitecross Box 4270 Williams Lake, B.C. V2G 2V3	Media
Duncan MacDonnell 99 7th Avenue, South Williams Lake, B.C. V2G 1L2	Media
Mike Shauer Box 5 Balfour, B.C. V0G 1C0	Tourism
Donna Underhill 10711 Springhill Cres. Richmond, B.C. V7E 1W7	Conservationist
David Aldcroft R.R. #1 Shawnigan Lake, B.C. V0R 2W0	Conservationist
Bill Glover (Executive Secretary) P.O. Box 608 Station A 701 West Hastings Street Vancouver, B.C. V6C 2N5	

E. SEP Community Advisors

Gary Taccogna
Department of Fisheries and Oceans
309-549 Columbia Street
New Westminster, B.C. V3L 1B3
Telephone: 524-7288
Radio Telephone: H486568

North Shore, Mainland and north side of Fraser River

Joe Kambeitz
Department of Fisheries and Oceans
309-549 Columbia Street
New Westminister, B.C. V3L 1B3
Telephone: 524-7288
Radio Telephone: H490450

South side of Fraser River drainage

Dennis Demontier
Department of Fisheries and Oceans
202-317 Seymour Street
Kamloops, B.C. V2C 2E9
Telephone: 374-9533
Radio Telephone: H490439

The central interior from Boston Bar to Prince George

Barry Peters
Department of Fisheries and Oceans
47218 Lazelle Avenue
Terrace, B.C. V9G 1R6
Telephone: 635-2206
Radio Telephone: H493528

Northern interior and north coast region

Tom Rutherford
Department of Fisheries and Oceans
Box 208
Queen Charlotte City, B.C. V0T 1S0
Telephone: 559-4754

Queen Charlotte Islands

George Bates
Department of Fisheries and Oceans
Box 10
Port Hardy, B.C. V0N 2P0
Telephone: 949-6181
Radio Telephone: H486570

Northern portion of Vancouver Island from Sayward on the east and Gold River on the west coasts and the Central coast

Bryan Allen
Department of Fisheries and Oceans
Box 1328
Comox, B.C. V9N 2Z0
Telephone: 339-0431
Radio Telephone: H493968

Central portion of Vancouver Island including Nanaimo, Port Alberni District

Trevor Morris
Department of Fisheries and Oceans
Room 116-816 Government Street
Victoria, B.C. V8W 1W9
Telephone: 388-3252
Radio Telephone: H493975

Lower Vancouver Island south of Chemainus watershed including Port Renfrew

Grant McBain
Department of Fisheries and Oceans
Box 10
Madeira Park, B.C. V0N 2H0
Telephone: 883-2613
Radio Telephone: H486569

Sunshine coast, Port Mellon to Cortes Island

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Glossary

Note: The definitions in this glossary are furnished by contributing writers and are relevant within the context of those writers' own sections.

activation: the process of initiating development in the fertilized egg after contact with water.

biomass: the weight or volume of biological material, e.g. - of zooplankton, phytoplankton, fish.

coelomic fluid: fluid in the body cavity.

cortisol: the principal cortical steroid hormone secreted by the interrenal tissue of salmon.

cryopreservation: storage of gametes (sperm and eggs) or embryos by freezing at very low temperatures.

double cropping: doubling the weight of fish produced per unit of space by moving the first group of fish out prematurely to another facility, (such as a rearing pen) or to a stream (by stocking fry) and rearing a second group of fish.

emigration: the downstream movement of juvenile fish.

female homogamety: existence of two similar sex chromosomes in the female.

fines: sand and silt measuring less than 0.1 cm or .01 m in diameter.

gabion: a wire basket filled with rocks and used for deflecting flows, protecting banks. Cylinder, wicker or woven metal bands are filled with earth for use in fortification for engineering.

gas bubble disease: in fish, is analogous to the "bends" in human divers, and occurs in supersaturated water.

glide area: a slow velocity, shallow stream section.

gonadotropin: the hormone which stimulates sexual maturation in salmon.

gynogenesis: a special form of parthenogenesis in which the egg is induced to develop without the contribution of chromosomes from the sperm.

histology: the study of tissue structure (microscopic anatomy).

hydraulic redd sampling: a method of collecting eggs and/or alevins from the gravel. Air and water are injected in the redd, using a small fire pump, and the eggs/alevins consequently float up and are collected in a net over the sample area.

hydrological survey: a survey or study of the waters of the earth, their occurrence, circulation and distribution, chemical and physical properties and reactions with the environment, including relation to living things.

imprinting: the process by which juvenile fish register environmental cues that enable them to return to their natal stream as adults.

interrenal: counterpart in fish to the adrenal cortex in higher vertebrates; the gland that produces the cortical steroids involved in the stress response.

kelt: a steelhead that has completed spawning.

lentic: "static water dwelling."

LHRH: a brain hormone which controls gonadotropin production and release.

limnetic: pertaining to the upper layer of the lake during the stratified period, i.e. May to October.

male heterogamety: existence of two dissimilar chromosomes in the male.

mesotrophic: having a moderate amount of dissolved nutrients; as in a moderately productive lake.

migration: the upstream movement of adults and occasionally juveniles (before smolting).

outplants: the juvenile fish transferred from a hatchery and released into their natal stream.

parthenogenesis: the development of an egg without fertilization.

radioimmunoassay: measurements of extremely low levels of biological substances, by displacement of labelled material bound to a specific antibody.

residuals: steelhead (usually male) that do not go to sea, but remain in the stream as residents.

satellite facility: a permanent central station for incubation and early rearing, serving several separate stocks. Sites on the "satellite" streams are used only during adult capture and juvenile imprinting through short-term rearing and may not require any permanent structures.

spermiation: final maturation of sperm in the testes prior to spawning, characterized by an increase in water content.

stripped groundwater: well water with its (usually) high nitrogen content removed; generally, the groundwater is stripped by passing it through an aeration tower.

teratogenicity: tending to cause developmental malformation.

topographical survey: a survey made to obtain data from which may be made a topographical map. The map indicates the relative positions and elevations of man-made and natural features of a place or region.

trophic levels: feeding or production levels in a biological community. For example, phytoplankton are primary producers, zooplankton are grazers, etc.

vibrio diseases: systemic bacterial infections. At least two separate species of bacteria belonging to the genus Vibrio are known to cause the disease. It affects only those fish which are held in salt water.

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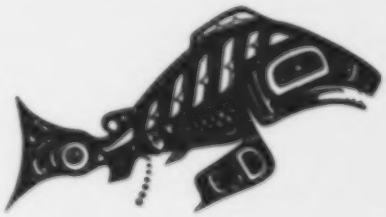

Fisheries and Oceans / Pêches et Océans

Province of British Columbia
Ministry of Environment

Salmonid Enhancement Program
Department of Fisheries and Oceans
1090 West Pender Street
Vancouver, B.C.
V6E 2P1

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